ENGINEERS & CONSULTANTS

DRAFT REPORT

DAM SAFETY INSPECTION REPORT

DAN RIVER STEAM STATION
ROCKINGHAM COUNTY, NORTH CAROLINA

SUBMITTED TO:

U.S. DEPARTMENT OF ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC

Engineering & Construction Management
Hydro-Nuclear-Fossil
Geotechnical Engineering
Seismic and Structural Engineering
Hydrological & Hydraulic Engineering
Tunnel Engineering
Environmental Engineering & Permitting

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PROJECT NO. 09-4157
JULY 2009

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1.0 EXECUTIVE SUMMARY

1.1 GENERAL

This Section is a summary of the Independent Engineer's Review of Management Units for the Dan River Steam Station. The Report was prepared by Paul C. Rizzo Associates Inc (RIZZO) for the United States Environmental Protection Agency (USEPA) under subcontract to Lockheed Martin. This Section summarizes the finding, assessments, conclusions and recommendations of the Independent Engineer.

The Dan River Steam Station is a coal fired power plant located on the north bank of the Dan River in Eden, Rockingham County, North Carolina owned and operated by Duke Energy Carolinas, LLC. Under normal operating conditions, byproducts of coal combustion including fly ash, bottom ash, boiler slag, flue gas emission control residuals, and other general wastewater products such as stormwater runoff and interior drainage are wet placed into an adjacent decantation basin.

The basin was originally constructed as a single embankment structure in 1956 using local borrow materials. The original structure was raised and made larger in 1967, and from 1976 to 1977 was raised and divided into two ponds by an intermediate dike. The resulting two basins are referred to as the Primary Pond and Secondary Pond, and are the subject of this report. For the purposes of this assessment, the Primary and Secondary Ponds have been classified as significant hazard potential structures. Significant hazard potential structures are classified as structures where failure is not likely to result in loss of life, but may cause significant economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. The predominant risk of failure for the Primary and Secondary Ponds is environmental damage.

In addition to the two "wet" storage ponds at the Dan River Steam Station, a dry ash storage area exists north of the ponds. This area was determined not to provide any dam safety concern during the field inspection as it consists of dry landfilled coal combustion waste (CCW) products that are capped and have well graded and well maintained slopes and surface drainage systems.

1.2 SUMMARY OF FIELD INSPECTION FINDINGS

The site inspection was conducted on May 27 - 28, 2009. The inspection team consisted of representatives from Duke Energy Carolinas, the USEPA, and RIZZO. The team stopped at each of the project features to inspect the structures and the surrounding area. Particular attention was paid to site features that may contribute to typical failure modes of embankment structures such as settlement, seepage, and slope stability.

The embankment comprising the Primary and Secondary Pond was found to be in good condition in general with a few areas of concern, chiefly seepage and shallow surface slides on the south (river) side of the embankment and the existence of animal burrows in the Secondary Pond south embankment. Existing embankment instrumentation and the overall site of the Dan River Steam Station appeared to be well maintained and in good working order.

1.3 SUMMARY OF O&M STATUS

The Project is attended full time by plant operators and dedicated safety personnel. Operation and maintenance procedures are well thought out and readily available to the site staff in the event of any questions to the procedure. The current inspection schedule for the Primary and Secondary Ponds consists of visual inspections monthly and after heavy rainfall events, an annual inspection, and a quintennial inspection performed by an outside consultant as required by North Carolina Utilities Commission (NCUC) regulations. The last 5 year inspection was performed in 2006 by MACTEC, with the next inspection planned for 2011. Generally, it was observed that the plant is well operated and well maintained.

1.4 CONCLUSIONS

1.4.1 Project Description

The Dan River Steam Station is a coal fired power plant. The Primary and Secondary Ponds were constructed to provide storage for waste coal combustion products and to provide necessary decantation capacity for the discharge water from the plant to comply with NPDES discharge permit requirements. In general, the ponds are embankment structures built with local borrow material and/or CCW products without internal drainage systems. Pool levels are controlled using stoplogs at concrete intake structures.

The CCW retaining structures of the Project have not had major changes since the last quintennial report performed in the year 2006. However, in response to the last 5 year inspection, additional instrumentation has been installed at three locations of interest on the southern embankment. This instrumentation is being monitored and the data compiled for submittal to and the development of potential remedial recommendations by MACTEC.

1.4.2 Field Inspection

Field inspection was performed in light of EPA guidelines, typical embankment failure modes and the recommendations of the previous 5 year inspection report. As noted in previous inspection reports, areas of seepage and surficial slides in the embankment material were noted. In addition, animal burrows were noted in the Secondary Pond embankment, and inspection personnel observed a monument system intended to track the erosion of the riverbank toward the structures. Recommendations were developed based on field observations and technical review of project documentation provided by Duke Energy.

1.5 SUMMARY OF RECOMMENDATIONS

There were a total of 5 recommendations resulting from the document review and field inspection. The recommendations are summarized below in ***Table 1-1*** and discussed in detail in **Section 4.0.**

TABLE 1-1: SUMMARY OF RECOMMENDATIONS

NO.	RECOMMENDATION	TIMEFRAME
1	Perform stability study for southern embankments and establish action levels	ASAP
2	Perform global stability calculation with regard to riverbank erosion	In conjunction with next annual inspection.
3	Nuisance animal control and backfilling of burrows	Ongoing as necessary.
4	Stump Removal	Within the next two years.
5	Completion of 6th Independent Consultant Report recommendations	As required by 6th Independent Consultant Report.

1.6 CERTIFICATION

1.6.1 List of All Field Inspection Participants

The field inspection was conducted from May 27 – 28, 2009. The individuals participating in the inspection were:

Stephen Hoffman	USEPA
Jesse Miller	USEPA
H. Grady Adkins, PE	RIZZO – Independent Engineer
Conrad Ginther, EIT	RIZZO
David Ray, EIT	RIZZO
Steve Townsend	Duke Energy Carolinas, LLC
Jeff Dunovant	Duke Energy Carolinas, LLC
Larry Evans	Duke Energy Carolinas, LLC
Robert Wylie	Duke Energy Carolinas, LLC
Laurence M. Cook	Duke Energy Carolinas, LLC
George Tolbert	Duke Energy Carolinas, LLC

1.6.2 Signature of Independent Engineer

I acknowledge that the management units referenced herein were personally inspected by me and was found to be in the following condition:

FAIR – due to recommendation for additional study.

Signature: _____

H. Grady Adkins, PE, NC Registration No. PE 035564
Independent Engineer
Paul C. Rizzo Associates, Inc.

1.6.3 PE Stamp

2.0 PROJECT DESCRIPTION

2.1 DESCRIPTION OF HISTORIC PROJECT FEATURES

2.1.1 Original Pond

The original coal combustion waste (CCW) pond was constructed in 1956, and consisted of a single embankment with a crest elevation of 523.5 feet. Based on historic drawings provided by Duke Energy, it appears that the original embankment was on the order of 20 feet to 25 feet high. This embankment was constructed of local borrow materials and was in operation to around 1968. In addition, two stormwater pipes pass under the original pond and discharge into the Dan River. Notes on historic drawings indicate that these pipes were installed with three feet of cover minimum. Detailed engineering reports and drawings for the original embankment were not provided as part of this review.

2.1.2 Single Pond Extension and Raise

From 1968 to 1969, the original pond was extended to the east along the Dan River on the order of 1200 feet and raised to have a crest elevation of 530'. Notes on historical drawings indicate that the extended embankment was built on existing grades to the east and at least partially on in-place ash to the west where the older embankment was being raised.

2.1.3 Construction of Intermediate Dike

An intermediate dike was constructed from 1976 to 1977, bisecting the extended pond into the Primary Pond and Secondary Pond. The intermediate dike was constructed to provide additional clarification of the wastewater prior to discharge into the Dan River, with a discharge structure constructed on the north side of the intermediate berm to connect the primary and secondary cells. In addition to the construction of the intermediate berm, the embankment around the Primary Pond was raised ten feet to have a crest elevation of 540'. The crest elevation of the embankment comprising the Secondary Pond was kept at elevation 530'. Based on notes on historical drawings, the raised portion of the Primary

Pond and the intermediate dike were built on top of existing ash deposits. The raised embankment portion of the Primary Pond was constructed by excavating ash near the crest of the existing embankment to provide a sort of keyway connecting the old and new embankments, presumably to provide seepage control by creating continuity between the old and new fills.

2.2 EXISTING PROJECT FEATURES AND HAZARD POTENTIAL CLASSIFICATION

2.2.1 Primary Pond

The Primary Pond at Dan River Steam Station consists of a composite embankment made up of local borrow materials, generally silty sands and sandy silts with some clay, on the downstream shell and either fill or CCW materials placed over the life of the Station. No internal drainage was provided in the construction of this Pond. The eastern side of the Primary Pond consists of the intermediate dike to elevation 530', constructed on in place ash deposits, and fill material constructed on top of the dike and ash deposits from elevation 530' to 540'. The Primary Pond has a crest elevation of 540', and was constructed with side slopes of 2H:1V. The southern (river) side of the Pond was provided with a rip rap liner up to elevation 512' and a rockfill berm up to elevation 503' alongside the river. An intermediate bench at elevation 530' was constructed during the last raise of the Pond's crest.

The Primary Pond has a surface area of approximately 27 Acres and a total storage capacity of approximately 477 acre-feet. The Pond was approximately 62 % full in January 2009.

The Primary Pond has been dredged at various times in its life, with the dredge spoils stored on site in a dry ash storage landfill to the north of the Ponds. According to site personnel, the last dredging was performed in 2007, and dredging is not expected to occur again due to impending decommissioning and replacement of the Dan River Steam Station.

Currently, combustion waste and other materials are pumped into the Primary Pond through sluice pipes entering the southwest corner of the basin. Pool elevations are controlled via a square reinforced concrete intake structure at the northeast end of the

Primary Pond. The pool elevation is controlled by adding or removing concrete stoplogs in two bays of the intake structure. Flows are carried to the Secondary Pond via a 36" diameter concrete pipe installed through the intermediate dike. No emergency spillway exists for the Primary Pond. According to the last quintennial inspection report, calculations performed by others indicate that the design storm event, a ¾ Probable Maximum Precipitation (PMP) event, will not overtop the Primary Pond embankment.

Based on field reconnaissance and a review of USGS maps and aerial photographs, the Primary Pond has been classified by the Independent Engineer as a significant hazard potential structure due to the environmental damage that would be caused by misoperation or failure of the structure. According the previous Independent Consultant Report, the Pond is classified as "low hazard" according to US Army Corps of Engineers criteria and has been declared "high hazard" by the State of North Carolina. Table 2-1 below summarizes the location information for the Secondary Pond.

TABLE 2-1: PRIMARY POND LOCATION DATA

	Degrees	**Minutes**	**Seconds**
Longitude	36	29	21
Latitude	-79	42	58
State:	North Carolina	**County:**	Rockingham

2.2.2 Secondary Pond

The Secondary Pond at Dan River Steam Station is generally made up of local borrow materials, typically silty sands and sandy silts with some clay. At the time of construction of the intermediate dike, ash in what was to become the Secondary Pond was removed and landfilled, however the Pond has not been dredged since completion of the intermediate dike separated the original pond. No internal drainage was provided in the construction of this Pond. The western side of the Primary Pond consists of the intermediate dike to elevation 530', constructed on in place ash deposits. The Secondary Pond has a crest elevation of 530', and was constructed with side slopes of 2H:1V. The southern (river) side of the Pond was provided with a rip rap liner up to elevation 512'.

The Secondary Pond has a surface area of approximately 12 Acres and a total storage capacity of approximately 187 acre-feet. The Pond was approximately 50 % full in January 2009.

The discharge structure for the Secondary Pond consists of a reinforced concrete tower provided with removable concrete stoplogs with a maximum elevation of 525'. Water from the tower flows into a 36" diameter concrete pipe which discharges into the Dan River. At the time of inspection, the outflow was clear. A weir assembly mounted to the outfall was in disrepair at the time of inspection. The discharge from the Secondary Pond is controlled by NPDES Permit #NC 0003468. No emergency spillway structure exists for the Secondary Pond. According to the last quintennial inspection report, calculations performed by others indicate that the design storm event, a ¾ Probable Maximum Precipitation (PMP) event, will have a peak flood elevation of 529.18' and therefore not overtop the Secondary Pond embankment. For this reason, emergency spillways have not been provided and do not appear to be necessary.

Based on field reconnaissance and a review of USGS maps and aerial photographs, the Secondary Pond has been classified by the Independent Engineer as a significant hazard potential structure due to the environmental damage that would be caused by misoperation or failure of the structure. According the previous Independent Consultant Report, the Pond is classified as "low hazard" according to US Army Corps of Engineers criteria and has been declared "high hazard" by the State of North Carolina.

The nearest downstream town from the outfall is Danville, Virginia, which is over 16 air miles from the site. The downstream site vicinity is characterized by agricultural/livestock operations and undeveloped rural areas. No critical infrastructure appears to be within 5 miles downstream of the structure. Table 2-2 below summarizes the location information for the Secondary Pond.

TABLE 2-2: SECONDARY POND LOCATION DATA

	Degrees	**Minutes**	**Seconds**
Longitude	36	29	31
Latitude	-79	42	47
State:	North Carolina	**County:**	Rockingham

2.3 SUMMARY OF STANDARD OPERATING PROCEDURES

2.3.1 Purpose of the Project

The Dan River Steam Station is a coal fired power plant. The Primary and Secondary basins were constructed to provide storage for waste coal combustion products and to provide necessary decantation capacity for the discharge water from the plant to comply with NPDES permit requirements. Currently the Station is in light production and slated for decommissioning and replacement by a new plant in the next few years. As such, additional ash loading of the pond is not anticipated to require the pond to be dredged or excavated again.

To date there have been no failures, overtopping events, or uncontrolled releases into the Dan River from the Primary or Secondary Pond. This assessment does not include discharges already recorded in NPDES records.

2.3.2 Current Inspection Schedule

The current inspection schedule for the structures at Dan River is as follows:

- **Visual Inspection by Site Staff**: Performed monthly and after heavy rainfall events.
- **Engineering Inspection by Duke Energy staff**: A more in-depth inspection, performed annually.
- **Quintennial Independent Engineer's Inspection**: An in-depth independent engineer's review of the structures performed at 5 year intervals required by the North Carolina Utilities Commission.

These inspections and their frequencies represent standard industry practice and represent adequate efforts for the protection of dam and public safety. In addition to safety inspections, an Emergency Action Plan (EAP) is being developed in conjunction with local authorities. A draft version of the EAP was provided by Duke personnel and appears to be in near final condition.

2.4 MODIFICATIONS CONDUCTED FOR PROJECT SAFETY

The CCW retaining structures of the Project have not had major changes since the last quintennial report performed in the year 2006. However, in response to the last 5 year inspection, additional instrumentation has been installed at three locations of interest on the southern embankment. This instrumentation is being monitored and the data compiled for submittal to and the development of potential remedial recommendations by MACTEC. The additional instrumentation and monitoring effort is discussed in more detail in **Section 3.0**.

3.0 FIELD INSPECTION

3.1 FIELD INSPECTION OBSERVATIONS

The site inspection was conducted on May 27 - 28, 2009. The inspection team consisted of representatives from Duke Energy Carolinas, the USEPA, and RIZZO. The team stopped at each of the project features to inspect the structures and the surrounding area. Particular attention was paid to site features that may contribute to typical failure modes of embankment structures such as settlement, seepage, and slope stability.

The individuals participating in the inspection were:

Stephen Hoffman	USEPA
Jesse Miller	USEPA
H. Grady Adkins, PE	RIZZO – Independent Engineer
Conrad Ginther, EIT	RIZZO
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Steve Townsend	Duke Energy Carolinas, LLC
Jeff Dunovant	Duke Energy Carolinas, LLC
Larry Evans	Duke Energy Carolinas, LLC
Robert Wylie	Duke Energy Carolinas, LLC
Laurence M. Cook	Duke Energy Carolinas, LLC
George Tolbert	Duke Energy Carolinas, LLC

3.1.1 Primary Pond

The Primary Pond at Dan River Steam Station consists of a composite embankment made up of local borrow materials, generally silty sands and sandy silts with some clay, on the downstream shell and either fill or CCW materials placed over the life of the Station. No internal drainage was provided in the construction of this Pond. The eastern side of the Primary Pond consists of the intermediate dike to elevation 530', constructed on in place ash deposits, and fill material constructed on top of the dike and ash deposits from elevation 530' to 540'. The Primary Pond has a crest elevation of 540', and was constructed with side slopes of 2H:1V. The southern (river) side of the Pond was provided with a rip rap liner up to elevation 512' and a rockfill berm up to elevation 503' alongside the river. An intermediate bench at elevation 530' was constructed during the last raise of the Pond's crest.

Overall, the Primary Pond embankment was found to have a good grass cover and with the exception of the southern (river) side to have smooth, even grades free of stumps, trees, brush or other deleterious vegetation. At the southwest corner of the embankment, several decaying tree stumps were found in the embankment toe and slope near the toe (see Photo 5 and Photo 6 in Appendix A). These stumps could present a hazard to slope stability, as well as potential seepage pipes as they decay. The rip rap toe berm and slope protection provided at the base of the southern embankment was generally in good condition and free of vegetation. The crest of the embankment and the elevation 525 bench appeared to be well graded and stable, with no signs of settlement noted at the time of inspection. Limited to no seepage or slope disturbance was noted along the southern embankment until approximately 1,200 feet southwest of the intermediate dike on the southern embankment. From this location to just past the intermediate dike, numerous small seeps (see Photo 9) were noted along the toe and up slope of the embankment. In addition, a wide, apparently active shallow surface slide was encountered around 800 feet west of the intermediate dike (see Photo 10 and 11). This failure surface has been noted in previous inspection reports and along with two other sections of increased seepage noted by the previous Independent Consultant are the subjects of recently installed additional instrumentation and study. At several locations along the Primary Pond embankment, shallow ruts and wallows caused by mowing equipment were noted (See Photo 14).

The survey monuments set up between the river bank and the embankment were noted. The monuments have been staked for easy identification and consist of steel pins driven into the ground. The monitoring system recommended by the previous consultant appears to have been installed as requested.

The Primary discharge structure was inspected and appeared to be in good condition and well maintained. According to site personnel, the concrete stoplogs are manually operated as necessary during active ash sluicing activities.

The intermediate dike dividing the Primary and Secondary Ponds appeared to be well maintained and in good condition, with a crushed gravel road across its crest and recently mowed slopes on the Primary Pond side (See Photo 12).

3.1.2 Secondary Pond

The Secondary Pond at Dan River Steam Station is generally made up of local borrow materials, typically silty sands and sandy silts with some clay. At the time of construction of the intermediate dike, ash in what was to become the Secondary Pond was removed and landfilled, however the Pond has not been dredged since completion of the intermediate dike separated the original pond. No internal drainage was provided in the construction of this Pond. The western side of the Primary Pond consists of the intermediate dike to elevation 530', constructed on in place ash deposits. The Secondary Pond has a crest elevation of 530', and was constructed with side slopes of 2H:1V. The southern (river) side of the Pond was provided with a rip rap liner up to elevation 512'.

Overall, the Secondary Pond embankment was found to to have a good grass cover and with smooth, even grades free of stumps, trees, brush or other deleterious vegetation. Limited seepage areas were noted on the southern/southwestern half of the river embankment near the intermediate dike, but were not as continuous as encountered in the Primary Pond. Animal burrows were noted at the time of inspection in the upstream bank of the embankment. According to site personnel, an animal control contractor had recently treated the site. It was not determined whether the burrow was still inhabited, but onsite personnel stated that they would contact the contractor again.

The Secondary discharge structure was inspected and appeared to be in good condition and well maintained. According to site personnel, the concrete stoplogs are manually operated as necessary during active ash sluicing activities. At the time of inspection , the outfall to the Dan River was flowing clear and the outfall structure and access stairs appear to be well maintained and in good working order. A weir device attached to the outfall pipe was in disrepair, so no flow measurements were able to be taken.

3.2 STATUS OF RESPONSES TO RECOMMENDATIONS IN LAST 5 YEAR INSPECTION

The following recommendations were made in ***Sixth Independent Consultant Inspection Report – Dan River Steam Station (2007)***, MACTEC Project 6234-06-3908.

3.2.1 Monthly instrumentation monitoring

Recommendation:

Monthly monitoring of basin level and piezometer/observation wells should be continued.

Status:

Monthly instrumentation monitoring and visual inspection of the structures has been continued.

3.2.2 Visual monitoring of wet area above access road (north embankment)

Recommendation:

The former wet area in the slope above the access road should be visually monitored. The railroad subgrade repair undertaken in May 2001 appeared to have dried up this area, but it has now apparently returned.

Status:

Visual monitoring of this area is part of the current monthly inspections.

3.2.3 Vegetation clearing in surface drainage feature under sluice pipes

Recommendation:

The vegetation in the valley under the sluice pipes, created by the primary basin dike and the adjacent plant roadway, should continue to be kept cleared enough to allow observation of the ground surface in this area so that water flowing into the valley can be observed for turbidity and removal of materials.

Status:

At the time of inspection, flow through the drainage feature crossing under the sluice lines was able to be observed at the outlet (a corrugated metal pipe), however the "valley" area immediately upstream of the outlet pipe was overgrown and swampy. Upstream of the deep area at the outlet pipe, the collection ditch is a well maintained mowed grass swale.

3.2.4 Drainage pipe outflow monitoring

Recommendation:

The outflow of the drainage pipes extending under the primary ash basins to the river should be monitored for turbidity in the discharge, which would be indicative of soil entrance into the pipes through leaks under the basin. The appearance of turbidity would make it advisable to perform a TV camera inspection of the pipe to determine if the leak or leaks area a threat.

Status:

Visual monitoring of the outflow from the drainage pipes that go under the Primary Basin is performed on a monthly basis. The outflow from these drainage pipes was clear at the time of the field inspection.

3.2.5 Slope movement

Recommendation:

The slump in the slope below the elevation 525 berm on the southern embankment of the primary ash basin facing the river has shown continued movement, along with seepage on the slope. This fresh movement and appearance of the seepage in this slump and

elsewhere along this slope are cause for an engineering investigation, including a soil test boring made on the elevation 525 berm for SPT and UD soil samples for laboratory testing and fitted with piezometers and/or an observation well. Also, we specifically recommend two additional borings with undisturbed samples for lab testing and installation of observation wells be performed on the 525 berm at seepage areas located about 80 ft south and 240 ft south of Piezometer No. 2.

Status:

At the time of inspection, the recommended instrumentation (OW4, OW5, OW6, and P12) had been installed and was being monitored. According to Duke staff, data collected will be sent to MACTEC for review and recommendations when a sufficient body of information has been collected to depict piezometric trends in the embankment sections in question.

RIZZO was provided with two reports submitted by MACTEC concerning the additional drilling and observation well installation performed as a result of the consultant's recommendations. Most notably, the report of the test borings and well installations indicates that seepage appeared to have been moving up the face up the embankment, as it was encountered higher than the levels noted during the last consultant's inspection.

3.2.6 Vegetation removal and control in rip rapped slopes

Recommendation:

In the 2001 report, it was recommended that the vegetation (small trees, vines, briars, etc.) growing in the rip rap on the slope of the embankments for the primary and secondary ash basins facing the Dan River should be cleared before late February, 2002. In 2006, this vegetation had been mostly controlled and both the rip-rap (elevation 512) and rockfill berm (elevation 503) were visible for inspection. However, trees are growing in the riprap north of the secondary stairs down to the Dan River and need similar removal. Vegetation in the rip rap should be controlled at least biannually using an appropriate herbicide. The grass cover on the slope above the rip rap should be continued to be maintained with mowing at least twice yearly all the way down the slope to the top of the rip rap.

Status:

At the time of inspection, it appeared that vegetation in rip rapped slopes was being properly controlled and that the grassed slopes were generally well covered with grass that had been relatively recently cut. Some rutting of the embankment slopes was noted, presumably caused by mowing activities. Continued vigilance on the part of Duke Energy will be required to maintain suitable conditions.

3.2.7 Seepage along the toe of the southern dike of the Secondary Pond

Recommendation:

The seepage along the toe of the southern dike for the secondary ash basin should be kept under observation during the yearly inspections for signs of increase in volume of erosion and slumping as the investigation in recommendation number 5 is completed and beyond.

Status:

Monitoring of the seepage through and surfaces of the southern embankment for the Primary and Secondary Ponds is performed monthly and as a part of the annual inspection. Pending the results of the recommendations from MACTEC, it should be continued until remediated. Monitoring of this seepage should be maintained as long as seepage is occurring.

3.2.8 Installation of river bank monuments

Recommendation:

As was noted in 2001, the steep river bank of the Dan River parallel to the toe of the eastern end of the primary ash basin dike and along all of the secondary basin dike appears to be unstable and possibly migrating toward the toe of the dikes. Its does not appear that the condition in 2006 is much different than in 2001. This indicates that the process is slow enough that its progress will likely not be detected in time to take remedial action unless a monitoring program is put in-place. Such a program would include, as a minimum, placing reference monuments beginning at the toe and at 5 ft spacing out to the river bank in a line perpendicular to the dike crest. During the annual inspections, the position of the top of the riverbank would be carefully document by reference to these monuments. Such lines of monuments should be installed in at least two locations in the

eastern part of the primary basin dike and at least three locations along the secondary basin dike.

Status:

During the site inspection, RIZZO personnel observed one of the lines of survey monuments installed at the recommendation of the independent consultant. Due to overgrowth along the riverbank, other monument strings were obscured, however, based on provided drawings it appears that the monument system was installed per the consultant's recommendations.

3.2.9 Nuisance animal activity

Recommendation:

Recent ground hog activity was noted at several locations above the rip rap on the downstream slope of the Secondary Ash Basin dike, along the Dan River. Burrowing animals such as groundhogs should continue to be controlled to the maximum extent practical. Maintenance of the present good grass cover with mowing two to three times per year, as is presently being done, will help to discourage burrowing activity by denying the animals protective cover.

Status:

At the time of the field inspection, two animal burrows were observed on the upstream embankment of the Seconday Pond. According to project staff, an animal control contractor had recently visited the site. Site staff stated that they would treat the new burrows with another visit by the trapper. Grass slopes appeared sufficiently maintained to discourage animal activity on the downstream faces of the embankments.

4.0 RECOMMENDATIONS

A total of five recommendations were generated during the preparation of this Inspection Report. All of the recommendations are considered Dam safety items. Each recommendation is presented below along with a proposed schedule to address the recommendation

4.1 RECOMMENDATION NO. 1

It is recommended that the stability study planned to be performed using the new instrumentation recommended in the last quintennial report and recently installed be performed as soon as enough data has been collected to provide an adequate baseline. In addition to re-evaluation of the embankment with the new data and in light of the apparent trend of seepage to move up the downstream face of the southern embankments, an incremental analysis should be performed to determine at what piezometric levels actions are required to remediate the structure. The embankments comprising the Primary and Secondary Ponds are susceptible to seepage based failure modes as they are constructed chiefly of silty materials and ash, have relatively steep design slopes, and were constructed without the benefit of internal drainage systems. It is possible that the surface slides noted in the inspection are related to localized pore pressure increases caused by the rising piezometric surfaces in the structures. As such, surface slides are likely to continue and potentially deepen if untreated.

Schedule: ASAP after a baseline trend has been established for the new instrumentation.

4.2 RECOMMENDATION NO. 2

It is recommended that in conjunction with continued monitoring of the riverbank movement monuments, a global stability study be performed to determine at what level of lateral movement of the riverbank that dam safety is compromised. Based on this analysis, action levels tied to the annual survey measurements should be established for remediation/stabilization of the riverbank.

Schedule: This analysis should be performed in conjunction with the next annual surveying of the monuments.

4.3 RECOMMENDATION NO. 3

It is recommended that efforts to control nuisance animal activity continue, including regular mowing of the embankments and removal of the animals. In addition, care should be taken when backfilling burrows, as improper or incomplete filling can provide a ready made conduit for piping type failure modes. Useful resources for dealing with nuisance animals in embankments are available at www.damsafety.org and are listed below:

- Plant and Animal Impacts on Earthen Dams - FEMA 540
- Dam Owners Guide to Animal Impacts on Earthen Dams (FEMA L-264)
- Technical Manual for Dam Owners: Impact of Animals on Earthen Dams (FEMA 473)

Schedule: The current animal control practices should be continued, with additional care taken when backfilling per the referenced resources..

4.4 RECOMMENDATION NO. 4

Several decaying stumps were noted in the area of the southwestern corner of the Primary Pond. These stumps should be removed as completely as possible without affecting embankment stability and the holes backfilled with compacted material that is compatible with the existing embankment. Useful resources for dealing with nuisance plants in embankments are available at www.damsafety.org and are listed below:

- Plant and Animal Impacts on Earthen Dams - FEMA 540
- Dam Owners Guide to Plant Impacts on Earthen Dams (FEMA L-263)
- Technical Manual for Dam Owners: Impact of Plants on Earthen Dams (FEMA 534)

Schedule: Stump removal and backfill should be performed within the next two years.

4.5 RECOMMENDATION NO. 5

The current inspection frequencies and site maintenance appear to be suitable for the structures inspected. Continued vigilance and adherence to current schedules is

recommended. In addition the recommendations provided in the 6th Independent Consultant Report (repeated in **Section 3.2**) should be completed per the recommendations of the Consultant.

Schedule: Per the recommendations of the 6th Independent Consultant Report.

APPENDIX A

DAN RIVER STEAM STATION PHOTO LOG

PHOTO 1: LOW HEAD DAM IN DAN RIVER (LOOKING SW)

PHOTO 2: SURFACE DRAINAGE OUTFALL BETWEEN PLANT AND POND (LOOKING N)

PHOTO 3: SOUTHWEST CORNER OF PRIMARY POND WITH SLUICE LINES (LOOKING NE)

PHOTO 4: SLUICE LINE DISCHARGE AREA AT SW CORNER OF PRIMARY POND (LOOKING NE)

PHOTO 5: STUMPS IN PRIMARY POND SOUTHERN EMBANKMENT SLOPE (LOOKING NE)

PHOTO 6: STUMPS IN PRIMARY POND SOUTHERN EMBANKMENT SLOPE (LOOKING NW)

PHOTO 7: SOUTHERN EMBANKMENT SECTION OF PRIMARY POND (LOOKING NE)

PHOTO 8: SURVEY MONUMENT SECTION PERPENDICULAR TO DAN RIVER (LOOKING S)

PHOTO 9: SEEPAGE AND SATURATED AREA AT TOE OF PRIMARY POND SOUTHERN EMBANKMENT

PHOTO 10: SURFICIAL SLOUGH OF PRIMARY POND SOUTHERN EMBANKMENT (LOOKING N)

PHOTO 11: SCARP OF SURFICIAL SLOUGH OF PRIMARY POND SOUTHERN EMBANKMENT (LOOKING NW)

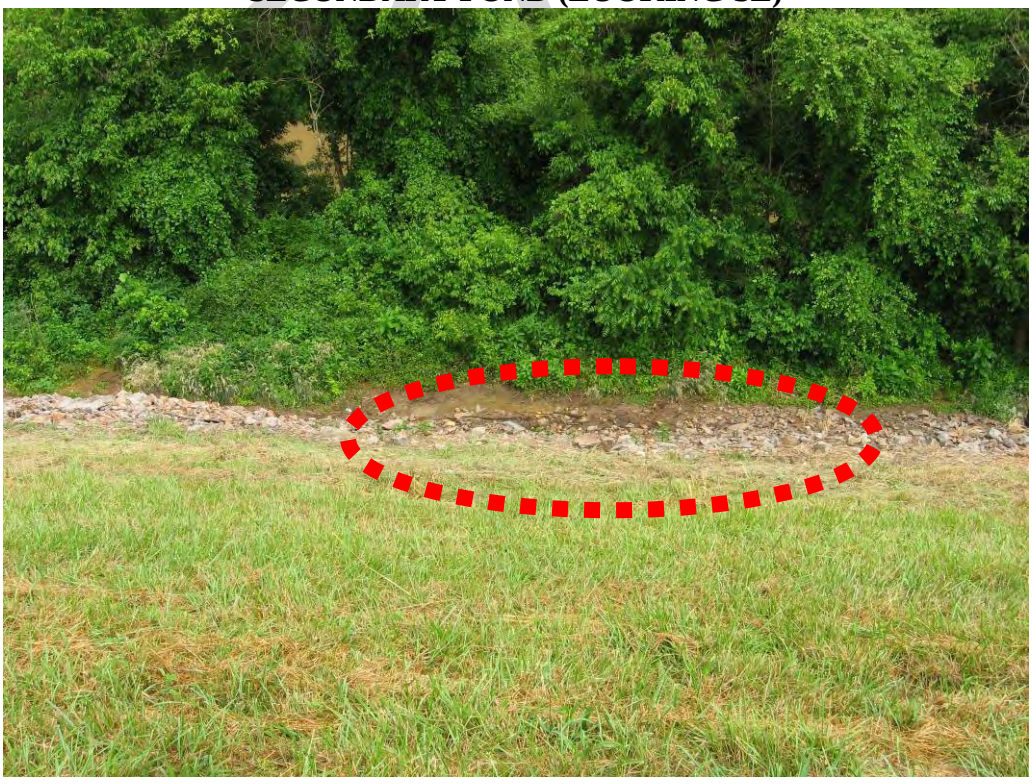
PHOTO 12: INTERMEDIATE DIKE CREST (LOOKING NW)

PHOTO 13: VIEW ACROSS PRIMARY POND FROM PRIMARY DISCHARGE TOWER (LOOKING SW)

PHOTO 14: RUTTING NEAR CREST OF SOUTHERN EMBANKMENT OF PRIMARY POND (LOOKING NE)

PHOTO 15: SOUTHERN EMBANKMENT OF SECONDARY POND (LOOKING NE)

PHOTO 16: WET AREA AT TOE OF SOUTHERN EMBANKMENT OF SECONDARY POND (LOOKING SE)



APPENDIX B

FIGURES

CAD FILE NUMBER	09-4157-B1
CHG	6/21/09
CHECKED BY	
APPROVED BY	
DRAWN BY	
PLOT	1=1

LEGEND

1. SEEPAGE ZONE ALONG SOUTHERN EMBANKMENT. NUMEROUS SURFICIAL SLIDES AND LOW VOLUME SEEPAGE.
2. ZONE OF RIVER BANK EROSION. MONUMENTS IN PLACE ALONG RIVERBANK TO MONITOR LOSS OF MATERIAL.
3. ANIMAL BURROWS NOTED DURING INSPECTION.

FIGURE 1

AERIAL VICINITY MAP
DAN RIVER STEAM STATION
DAM SAFETY INSPECTION
PREPARED FOR

USEPA
WASHINGTON, D.C.

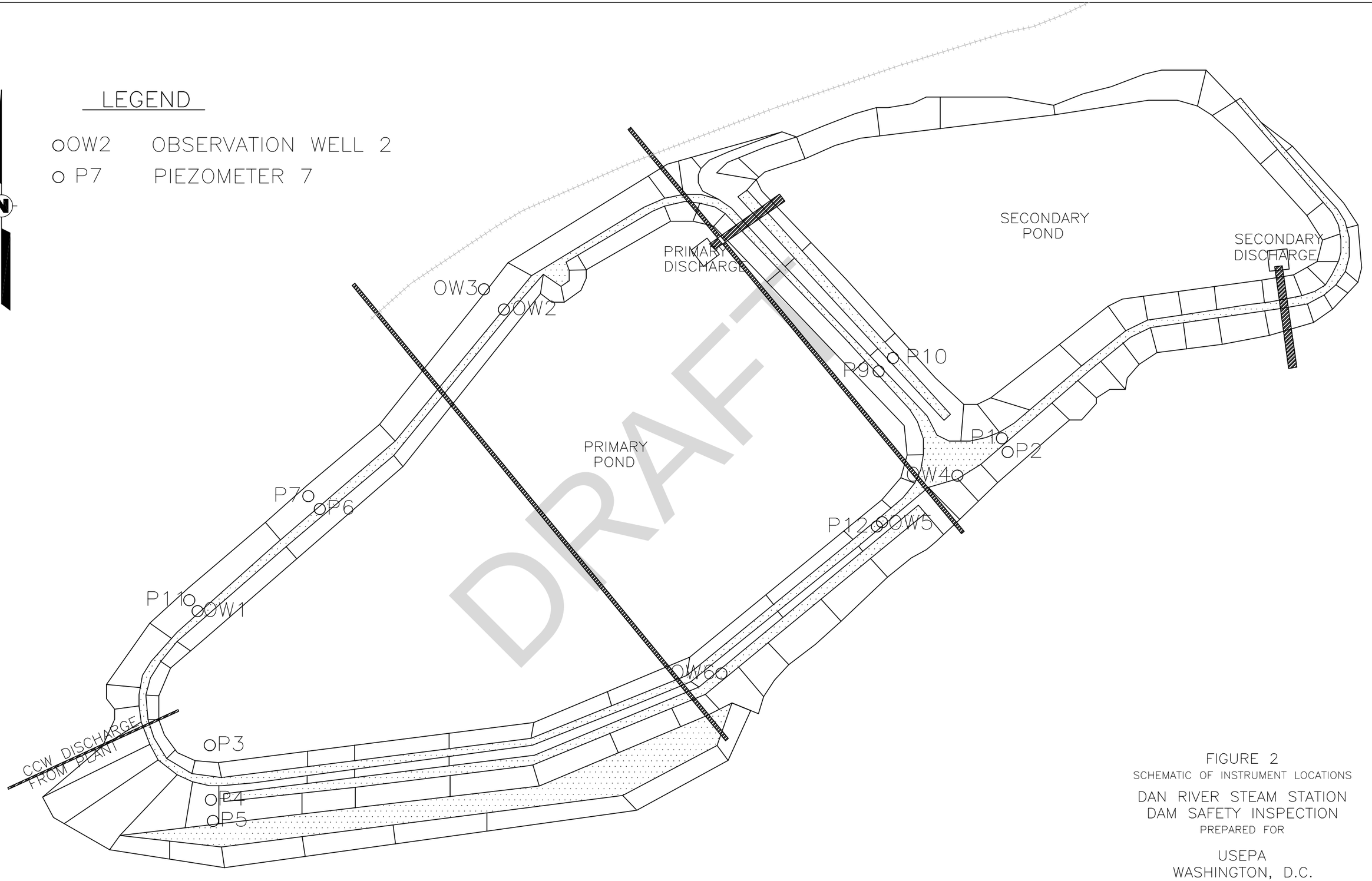
Paul C. Rizzo Associates, Inc.
ENGINEERS & CONSULTANTS

CAD FILE NUMBER	09-4157-B1
CHG	6/21/09
CHECKED BY	
APPROVED BY	
DRAWN BY	
PLOT 1=1	

LEGEND

oOW2 OBSERVATION WELL 2

o P7 PIEZOMETER 7



NOTE: DRAWING DIGITIZED FROM HARD COPY FIGURES. INSTRUMENT LOCATIONS ARE APPROXIMATE. APPROXIMATE SCALE 1":200'

FIGURE 2
SCHEMATIC OF INSTRUMENT LOCATIONS
DAN RIVER STEAM STATION
DAM SAFETY INSPECTION
PREPARED FOR

USEPA
WASHINGTON, D.C.

Paul C. Rizzo Associates, Inc.
ENGINEERS & CONSULTANTS

APPENDIX C

PREVIOUS INDEPENDENT CONSULTANTS REPORT

SIXTH INDEPENDENT CONSULTANT INSPECTION REPORT
ASH BASIN DIKES
DAN RIVER STEAM STATION
ROCKINGHAM COUNTY, NORTH CAROLINA
PERFORMED NOVEMBER 14, 2006

Prepared for:

DUKE POWER COMPANY

Charlotte, North Carolina

Prepared by:

MACTEC ENGINEERING AND CONSULTING, INC.

Charlotte, North Carolina

February 19, 2007
MACTEC Project No. 6234-06-3908

MACTEC

MACTEC

engineering and constructing a better tomorrow

February 19, 2007

Mr. Larry D. Evans
Environmental Coordinator
Dan River Steam Station
Duke Power Company
900 South Edgewood Drive
Eden, North Carolina 27288

Subject: **Sixth Independent Consultant Inspection Report**
Ash Basin Dikes
Dan River Steam Station
Rockingham County, North Carolina
MACTEC Project No. 6234-06-3908

Dear Mr. Evans:

MACTEC Engineering and Consulting, Inc. (fka Law Engineering & Environmental Services, Inc.) is pleased to transmit the attached report of our five year independent consultant inspection of the ash basin dikes at Dan River Steam Station. The inspection was performed in accordance with Duke Power Company's Specifications No. 5102.00-00-0001 *Specifications for Inspection of Facilities as Required by the North Carolina Utilities Commission.*

The inspection noted seepage at various locations on the downstream slope of the Primary and Secondary Ash Basin Dikes, alongside the Dan River. In addition, a sloughed area of this downstream slope that was inactive from 1996 to 2001 showed activity since 2001. Recommendations are given herein for installation of piezometers/observation wells in these areas to monitor the phreatic surface and for soil test borings with undisturbed sampling to evaluate the subsurface conditions. New slope stability analyses may be required, depending on the monitoring results of the newly installed wells and piezometers. The Dan River bank appears to continue to be migrating toward the toe of the secondary basin dike, and stabilization works may be required to armor this area against further riverbank erosion and sloughing.

We appreciate the opportunity to provide our professional services to you on this project. Please let us know if you have any questions.

Very truly yours,
MACTEC ENGINEERING AND CONSULTING, INC.

Mel Y. Browning, P.E.
Principal Geotechnical Engineer
Registered, N.C. 8696

Clay E. Sams, P.E.
Senior Principal Engineer
Registered, N.C. 4459

MYB/CES:cvh

DUKE POWER COMPANY
DAN RIVER STEAM STATION

ASH BASIN DIKES
ROCKINGHAM COUNTY, NORTH CAROLINA

MACTEC PROJECT 6234-06-3908

SIXTH INDEPENDENT CONSULTANT INSPECTION
Performed November 14, 2006

BY

MACTEC ENGINEERING AND CONSULTING, INC.
CHARLOTTE, NORTH CAROLINA

REPORT PREPARED BY

MEL Y. BROWNING, P.E.
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and

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SENIOR PRINCIAL ENGINEER
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TABLE OF CONTENTS

1. INTRODUCTION

1.1 DISCUSSION

This work was performed to provide the five year independent consultant inspection as required by the North Carolina Utilities Commission (NCUC) for facilities operated by Duke Power Company in North Carolina and not licensed by the Federal Energy Regulatory Commission (FERC). This independent inspection constitutes the sixth such inspection at the Dan River Steam Station.

The four most recent previous independent consultant inspections were performed by Law Engineering Testing Company in 1986 (Job No. CHW-5475) and WKD Geoscience in 1991 (Job No. 11008) and by Law Engineering & Environmental Services, Inc. in 1996 (Job No. 30100-6-2038) and in 2001 (LAW Job No. 30100-1-0949). The results of these inspections were presented in reports dated June 20, 1986, October 23, 1991, November 20, 1998 (the inspection field work was performed December 30, 1996 but the final report was not issued until 1998), and December 18, 2001. These reports were reviewed as part of our independent inspection services. No available annual inspection reports prepared by Duke Power Engineers since the last five year independent consultant's inspection in 2001 were available for review as part of this independent inspection.

1.2 SCOPE OF SERVICES

The scope of services is in general accordance with the "Recommended Guidelines for Safety Inspection of Dams" prepared by the Department of the Army, Office of the Chief of Engineers and dated May, 1976. The purpose of the inspection was to develop an assessment of the general conditions with respect to safety of the dikes based on available data and a visual inspection, to determine any need for emergency measures and conclude if additional studies, investigations and analyses are warranted.

Available relevant reports on the safety of the ash dikes inspected were reviewed. The field work included a systematic visual inspection of the ash dikes including documentation through photographic records. Particular attention was given to observing leakage, erosion, seepage, slope instability, settlement, displacement, tilting, cracking, deterioration and improper functioning of drains.

Based upon the review of available engineering data and on the field observations, an engineering opinion is given as to the general condition of the dikes as well as an assessment of the quality and adequacy of maintenance, surveillance, and methods of project operation for protection of public safety.

2. PROJECT INFORMATION

2.1 LOCATION

The Dan River Steam Station is located approximately thirty-five miles north of Greensboro in Rockingham County, North Carolina. The station is located on the north side of the Dan River in the southeast portion of Eden, North Carolina. The ash storage basins and dikes are located on the east side of the existing power plant. The project location is shown on Figure Nos. 1 and 2, contained in Appendix A of this report.

2.2 DESCRIPTION

2.2.1 Brief History

Construction for the original ash retention basin began in 1956. Several modifications have been made to the original basin since that time. The original configuration consisted of a storage basin located adjacent to the Dan River. The basin contained only a primary cell with crest elevation 524.5 ft (MSL). In 1968 and 1969 the earth dikes were raised and extended to cover the total basin area presently occupied by the existing primary and secondary basins as shown on Figure No. 3. The intermediate dike dividing the primary and secondary basins was constructed in 1976 and 1977 to improve the effluent quality by staging the sluice discharge.

A newer dike was constructed north of the primary and secondary basins in 1980 primarily for the storage of dry ash. This newer dry ash storage basin contains an earth filled dike approximately 2,100 ft in length. This dry storage basin was divided by a 620 ft long earth filled dike perpendicular to the 2,100 ft long earth dike to form a dredge pond used to hold ash dredged from the primary basin. This dredge pond is currently used to store dry ash.

2.2.2 Ash Basins

Various sections through the basin dikes are shown on Figure Nos. 4, 5, and 6. The ash storage basins were designed with side slopes of two horizontal to one vertical (2 (H) : 1 (V)). The design crest elevations for the primary and secondary dikes are, respectively, 540 feet and 530 feet. The outside (or downstream) slope adjacent to the Dan River is rip-rap lined from the toe of the slope to elevation 512 ft. A wide rock filled berm was constructed at elevation 503 ft on the downstream portion of the primary basin dike, next to the

Dan River. According to the information provided, the dikes constructed before 1980 have no internal drainage.

Two stormwater drainage pipes pass under the existing primary basin and discharge into the Dan River. These storm drainage pipes were apparently part of the original basin design.

The primary basin encompasses approximately 5 acres. The ash sluice presently discharges into this primary basin from the adjacent plant. The ash settles in the primary basin with the water drained off through a reinforced concrete drainage tower with a 36" diameter discharge pipe located at the bottom of the tower. The discharge tower is an 8 feet, 8 inch square tower with two 48" openings on both sides of the tower. The openings are fitted with removable precast concrete stoplogs. The stoplog elevation can be adjusted to lower or raise the water level in the basin; the maximum stoplog elevation is 535 ft (MSL). The 36" diameter discharge pipe at the bottom of the tower extends under the divider dike into the secondary basin.

The discharge tower for the secondary basin is located in the southeastern portion of the basin adjacent to the Dan River. The secondary basin discharges into a 175 ft long, 36" reinforced concrete pipe that extends under the southeastern portion of the secondary dike. A walkway constructed of treated timber provides access to the drainage tower. The tower has a variable weir opening 48 inches wide with removable precast concrete stoplogs to control the level of the basin. The maximum stoplog elevation is 525 feet.

2.2.3 Dry Storage Basin and Dredge Pond

The dry storage basin and dredge pond dike located north of the primary and secondary basins were designed to have side slopes on the order of 2.5 (H) : 1 (V). Both the dry storage basin dike and the dredge pond dike were designed for a crest elevation of 560 feet. Crest widths were designed to be 15 ft for the dry storage basin and 12 ft for the dredge pond dike. The maximum height of the dry storage basin dike is approximately 40 ft above the toe; this dike contains an internal drainage blanket. The maximum height of the dike for the dredge pond is approximately 25 ft; no toe drain or other internal drainage was incorporated in the design of this dike. There is, however, a rip-rap lined ditch along the entire downstream toe of the dike.

The dry storage basin and dredge pond encompass approximately eight acres. As mentioned previously, the dredge pond is currently used to store dry ash.

The dry storage basin drainage tower is constructed of reinforced concrete with a 36" diameter discharge pipe at the base of the tower. This pipe extends approximately 600 ft under the dry storage basin dike and discharges into the secondary ash storage basin to the south. The discharge tower itself is approximately 8 ft, 4 inches by 9 ft in plan area and has a variable weir opening of five feet. Removable precast concrete stoplogs on two sides control the level of the basin.

A more detailed account of the historical developments for the design, construction, operation and instrumentation monitoring of the ash storage facilities is present in the 1981 and 1986 five-year independent consultant's reports.

2.2.4 Emergency Spillways

There are no emergency spillways for any of the primary, secondary, dry storage, or dredge pond basins.

2.3 SIZE CLASSIFICATION

The maximum height of 60 ft for the Dan River Steam Station's primary and secondary ash storage basin dikes dictates the size classification. In accordance with the U.S. Army Corps of Engineers' guidelines, these dams would be classified as "intermediate" size dams; however, by the criteria in the North Carolina Dam Safety Regulations these dams would be classified as "large" dams. The Corps of Engineers' intermediate size classification would also apply for the dry ash storage basin dike, however, the 40 ft height would qualify this for a "medium" size classification by the North Carolina standards. By either criteria the dredge pond dike would be classified as a "small" size dam.

2.4 HAZARD CLASSIFICATION

The dikes at the Dan River Stream Station are considered to be "low hazard" dams under the criteria of the Army Corps of Engineers. However, the State of North Carolina has declared the dikes to be "high hazard".

2.5 GEOLOGY AND SEISMICITY

The Dan River Steam Station is located within the Piedmont Physiographic Province of North Carolina. According to the published geologic information, the site lies within the Dan River Group of the Triassic Basin within this physiographic province. The rock types underlying the station are primarily red to brown and green to brown sandstone, mudstone and conglomerate. A more detailed description of the geology can be found in the 1986 independent consultant report.

The Dan River Steam Station lies within the Seismic Zone 1 according to the Uniform Building Code Seismic Zone Map of the United States published by the Army Corps of Engineers. According to the publication "Recommended Guidelines for Safety Inspection of Dams", projects that are located in Seismic Zone 0, 1, and 2 are considered to present "no hazard from earthquakes, provided static stability conditions are satisfactory and conventional safety margins exist". According to the Corps of Engineers Publication ER 1110-2-1806 dated 31 July, 1995, "Earthquake Design and Evaluation for Civil Works Projects, consideration of the presence of liquefaction susceptible materials in the dam or its foundation is necessary for projects located in Seismic Zone 2 (or 2A). The Dan River Station lies in Seismic Zone 1 and thus would not be directly subject to this criterion.

3. ENGINEERING AND OPERATIONAL INFORMATION

The ash basins and associated dikes were constructed in phases from about 1954 up through the present. Major addition work was performed in 1956, 1968, 1976, and 1980. Engineering studies for the 1968 and earlier dikes are not readily available. Law Engineering Testing Company performed a subsurface exploration in 1974 to evaluate the subsurface conditions and geotechnical parameters for the in-place fill, ash, and foundation soils and to evaluate potential borrow soils.

Additional design studies were performed for the 1976 modifications by Duke Power. These studies included a slope stability analysis for the dry ash storage basin dike. Further design studies were conducted in 1982 for the dredge pond dike. A subsurface exploration, laboratory testing, slope stability analyses, and hydrologic analysis were all done in-house by Duke Power. A reanalysis of the slope stability for primary, secondary, and intermediate dikes based on the 1982 geotechnical data was performed by Duke Power engineers in 1984-1985.

3.1 SLOPE STABILITY

The soil strength parameters used for the slope stability analyses in 1984-1985 are outlined in the 1986 independent consultant's report. These soil parameters and the existing slope geometries were used with a computer program (LANSLI) which uses a method of analysis similar to Ordinary Method of Slices for the analysis of static slope stability. The results of the 1984-1985 analyses are tabulated below.

	1985 Analyses Factor of Safety Steady-State Operation	1985 Analyses Factor of Safety Rapid Drawdown
PRIMARY BASIN		
Upstream Slope	1.36*	1.27
Downstream Slope	1.40**	(El 535-El 530)
SECONDARY BASIN		
Upstream Slope	3.43	2.58
Downstream Slope	1.45+	(El 527-El 522)
INTERMEDIATE DIKE		
Upstream Slope	1.42**	1.27
Downstream Slope	>1.50	1.27

* - F.S. for approximately 9-ft.deep potential failure arc. All other F.S. are > 1.50
** - F.S. 1.30 to 1.40 for potential failure arcs < 5 ft deep.
\+ - F.S. calculated for shallow failure arc; deeper failure arcs have F.S. > 1.50

The minimum factor of safety against slope failure is outlined in "Recommended Guidelines for Safety Inspection of Dams", prepared by the U. S. Army Corps of Engineers. The criteria for steady-state operation and rapid drawdown conditions are minimum factors of safety of 1.5 and 1.2, respectively. In 1976 Law Engineering recommended and Duke Power adopted slope safety factors of 1.25 for end of construction and 1.4 for steady state seepage conditions. As outlined in the previous independent inspection reports the calculated factors of safety for Duke Power's 1985 analyses generally meet or exceed the minimum safety factor criteria. However, one section of the primary basin dike, as reported in LAW's 1986 independent inspection report, was computed to have a factor of safety of 1.36 for an approximately 9 ft deep potential failure arc under steady state conditions and factors of safety in the range of 1.3 to 1.4 were computed for very shallow potential failures along other dike slopes under steady state conditions. In all cases, a factor of safety greater than 1.5 was computed for deep seated potential failure arcs under steady seepage conditions for all dikes.

Since the 1985 analyses, monitoring of the piezometers (Chapter 6) has disclosed phreatic or piezometric levels that are higher than those used in the analyses. For the 1996 Inspection Report, re-evaluation of the borings for the 1976 and 1982 studies indicated that the 1956 embankment along the river in the primary basin includes ash and soil mixed. The reinterpreted cross section is shown on Figure 8. In 1997, Duke Power re-analyzed the affected cross section with the results on Figure 8 as follows:

	1997 Analyses Factor of Safety Steady-State Operation
PRIMARY BASIN Downstream Slope Deep Surface	1.45*

* Minimum perpendicular depth of potential failure arc used in the analysis = 10 ft.

The 1997 analysis on Figure 8 showed a safety factor of 1.45 for deep failure surfaces in the downstream embankment, down from greater than 1.50 safety factor on comparable surfaces in the 1984-1985 analyses.

During a monthly inspection conducted by Duke Power in September, 2005, seepage was discovered on the downriver (eastern) half of the Primary Basin slope, below the 525 berm. This seepage condition was continuously noted during remaining monthly inspections in 2005 and in 2006. This seepage area is located at approximately STA 17+50, close to where the 48 inch RCP extends under the Primary Ash

Basin. In May 2006, this seepage was noted to have moved up the slope from previous observations. In November 2006 at the time of the independent inspection reported herein, seepage was noted on the slope up to the 525 berm elevation. In September, 2005, Duke performed a revised slope stability analysis, based on the section at STA 9+01 used for the previous 1997 analysis. For the revised 2005 analysis, the analyzed phreatic surface (see Figure 8) was raised to reflect the September 2005 field observations. (MACTEC was not furnished the elevation of the observed seepage at this time). The resulting factor of safety was 1.36. This 2005 result is documented in a 2006 email from Mr. Michael Martin to Mr. Gary Blevins dated September 11, 2006. An observation stated in the email was that seepage in the wet area observed in September 2006 was about 2 ft higher than was present in the September 2005 analysis, thus in September 2006 the factor of safety would have been lower than computed in September 2005 and reported in the referenced email.

3.2 HYDROLOGY AND HYDRAULICS

An Ash Basin Flood Study was performed in 1987 by Duke Power Company engineers for the Dan River Steam Station. The flood study was performed in response to the North Carolina Public Staff Utilities Commission's request that Duke Power Company provide a report addressing the hydrologic safety of the Ash Basin dikes. The State of North Carolina declared these dikes are classified as high hazard and must be capable of safely storing or passing 3/4 Probable Maximum Precipitation (PMP) storm event in the Wet Ash Storage Basin, a 1/2 PMP in the Dry Ash Storage Basin and 1/3 PMP in the Dredge Pond.

On March 26, 1987, LAW reported on their review of the Duke's Ash Basin Flood Study (LAW Job File CHW-5475A). The documents reviewed included output from the U.S. Army Corps of Engineers - HMR52 computer program for the 3/4 PMP, output from the Hydrologic Engineering Center's HEC-1 Flood Hydrograph Package computer program for the flood routing through the Ash Basins, copies of hand calculation supporting selection of hydrologic parameters used in the computer simulations and various engineering figures depicting the Ash Basin system. These data were used to determine the peak flood elevations in each of the basins resulting from the 3/4 PMP. Based on field survey results, a crest elevation of 560.5 ft-msl for the dike forming the southern boundary of the Dry Ash Storage Basin and Dredge Pond was used to analyze the flood routing results. The dike surrounding the Secondary Basin has a crest elevation of 530.0 ft - msl according to the figures.

Based on the material reviewed, it was Law Environmental's opinion that acceptable hydrologic techniques were used to estimate peak elevations in each of the ponds within the Ash Basin system. The results of this study indicated that only the divider dike between the Dredge Pond and the Dry Ash Storage Basin is overtopped by up to about 6 inches for 2.25 hours over approximately 90 linear feet of the dike. Law Environmental concluded that, if this overtopping caused a failure of the divider dike, the resulting peak water surface elevation in the Dry Fly Ash Basin would be approximately 2 ft higher than the peak water surface elevation without failure and would not cause overtopping of any other dike. The computed peak flood elevation in the Secondary Basin (529.18 ft-msl) due to the 3/4 PMP is below the top of dike elevation (530-0 ft-msl) and thus, LAW concurred with Duke's conclusion that an emergency spillway is not necessary at this location.

3.3 OPERATIONS RELATED TO PUBLIC SAFETY

Routine inspections and maintenance, as required, are performed at the Dan River Steam Station as part of Duke's safety related operations of the dam. Plant personnel perform routine inspection during the normal upkeep operations at the site. Prior to 2001, Duke engineers made annual inspections and prepared written reports documenting their observations and recommendations. However, since 2001, the previous program of annual inspections performed by Duke engineers, has not been maintained. Duke retains an independent consultant to perform the five-year inspections required by the North Carolina Utility Commission regulations. The results of these inspections are documented by written reports.

4. FIELD OBSERVATIONS

Field observations were performed on November 14, 2006 on a calm, partly cloudy day. Messrs. Clay E. Sams, P.E. and Mel Y. Browning, P.E. of MACTEC, Mr. Larry D. Evans of Duke's Group Environment, Health & Safety Department were present during a portion of the field observations made on the south downstream slopes of the primary and secondary ash basin dikes, alongside the Dan River. The water level in the primary and secondary basins during the time of our site observations was 533.85 and 524.30 ft., respectively. The field observations are outlined below; Figure No. 3 indicates the location and direction of the photographs referenced in the following paragraphs.

4.1 PRIMARY AND SECONDARY BASIN DIKES

Field observations herein are sequenced beginning at the northern end of the intermediate dike and proceeding conterclockwise around the primary basin and secondary basin. Photographs No. 1 and No. 2 provide views of the crest and upstream slope of the intermediate dike. The meteorological tower in Photograph No. 1 was installed since the 2001 inspection. In general, this dike appears to be in good visual condition. Minor ponding in wheel tracks that was visible in Photograph No. 1 in 1996 were corrected by road maintenance in 2001. Currently, some minor depressions in wheel tracks are visible in Photographs No. 1 and 2 but without ponding. A good uniform ground cover exists on the upstream side of the embankment as shown in Photograph No. 2. The upstream slope steepens at an elevation estimated to be 6 ft below the crest. This is probably related to past wave cutting. Photograph No. 4 (no current Photograph No. 3) is a view of the downstream slope for the intermediate dike and of the rock berm on the downstream side of the intermediate dike. Small bushes that were becoming established in the rock fill in 2001 have been removed. To the right of this photograph is the secondary basin. No depressions, tension cracks, or other signs of instability were observed on the intermediate dike.

Photograph No. 5 provides a view of the primary ash basin discharge tower located adjacent to the northern portion of the intermediate dike. The visible part of the drainage tower appears to be in good condition. Per Photograph No. 6, the access ramp to the discharge tower is in good repair and has been replaced since 2001. The flow from the primary discharge tower appeared to be clear and no ruts or depressions were observed on the intermediate dike above the outlet pipe or the primary discharge tower.

The primary basin dike, in general, appears to be in good visual condition. A fairly good ground cover exists on the upstream, crest and downstream portions of the dike. No depressions, ruts, or other signs of instability were observed in the crest. Photographs No. 7 and No. 8 are views of the crest of the northern portion of the primary basin dike. At Photograph No. 8, the downstream dike slope was wet in 1996 above the access road angling up to the crest in the right side of the photograph, but this slope location was dry in 2001. In 1996, the slope had been "notched" or intruded into by maintenance operations on this road, but this had been stopped in 2001. In 2006, a notch has reappeared higher above the road than in 1996. In about May, 2001, a wet subgrade that was judged a potential detriment to support for the railroad tracks was repaired across from this location (beyond the right end of Photograph No. 8); it was reportedly felt that this wet subgrade was due to seepage from the primary basin. The railroad repair area is visible in Photograph No. 8A; note the proximity of the access road angling up the dike as mentioned in Photograph 8. It is possible that the railroad repair, which reportedly included some subsurface drainage, lowered the seepage line and thus dried up the access road area. This area has remained dry since the 2001 inspection. (No subsurface drain outlet in this locality was observed during the 2001 or current field inspection). In association with the 2001 repair work, two new observation wells (OW2 and OW3) were added in this area of the dike on October 23, 2001. Photographs No. 9 and 10 provide views of the downstream slope of the primary basin dike adjacent to the power plant access road.

Angled power poles in this area were visible in the 1991, 1996 and 2001 inspection photographs. These poles are loose in their embedment and in 2001 leaned in an opposite sense to the lean direction in 1991 and 1996. In 2006, the lean direction was the same as in 2001. These poles are located at about the toe of the 1976 fill intersection with the elevation 530 fill placed in 1968 (section D-D, Figure No. 4); their tips may be embedded in ash below the fill, thus leading to their loose condition. This suggests the ash removal (1976) depicted on Section D-D may have been incompletely accomplished. Minor rutting observed in 1991, 1996 and 2001 on the surface of the slope in this area was still present in 2006. Apparently this rutting is caused by the maintenance equipment mowing the grass on the face of the dike.

The ditch beside the plant access road just outside the chain link fence visible in the left side of Photograph 9 and the right side of Photograph 10 is wet from seepage in 2006 as was the case in 2001. This is consistent with the phreatic line indicated by piezometers 6 and 7 as depicted on Figure 7. The ditch beside the plant access road is depicted in Section D-D on Figure 4. The dike road crest in the background of Photograph No. 9 contains water-filled potholes in the wheel tracks, opposite piezometers P-6 and P-7 visible in the photograph. There were also some other shallow depressions in the wheel track

farther to the north. Photograph No. 11 provides a view of the crest and downstream slope of the southern portion of the primary basin dike in the vicinity of the sluice pipes. Photograph Nos. 12, 13, 14, and 15 provide views of the ash sluice and wastewater sump lines which extend from the plant into the basin. A groundhog's burrow observed in 1996 near the location of Photograph 12 was not observed in 2001. However, in 2006, a ground hog burrow was observed beyond the rock fill in the photograph. The wet area noted in the 1991 report on the downstream slope in the upper left side of Photograph No. 13, was not apparent in the 1996, 2001 and current 2006 inspections. The shallow slump in the slope in Photograph No. 13 that had formed between 1991 and 1996 had been repaired in 2001 and has remained stable. A 36" diameter corrugated metal pipe is present below the white ash sluice line in Photograph No. 12. This pipe, along with other yard drain pipes, discharges water into the valley between the toe of the basin and the toe of the embankment for the access roadway. This water flows through the valley to the inlet of another 36" diameter corrugated metal pipe culvert near Photograph No. 15. Since 2001, it appears that the piping seen in Photograph No. 15 was realigned, placing a bend at the bottom of the picture that was not visible in the corresponding 2001 photograph.

Photograph Nos. 16, 17, 18, 19, 20, and 21 provide views of the crest and downstream slopes for the primary basin dike, adjacent to the Dan River. Groundhog burrows, observed on the downstream slope near Photograph 16 in 2001, were not evident in 2006. A good grass cover exists over this dike above the rip rap. Signs of instability were observed; the shallow slump visible in 2001 Photograph 19A and 19B below the elevation 525 berm has moved since 2001. Observation of this locality should be continued in future routine and annual inspections to see if it continues to enlarge. The slump is located approximately 150 ft east of the slight bend in the dike alignment visible in Photograph 19. There is also new seepage emerging on the slope in this area since 2001, below the 525 berm. In the vicinity of Photograph No. 21, there is a significant seep about midway between the rip rap (512) and the 525 berm. About 80 ft south of piezometer 2, shown in Photograph No. 21 in a direction toward the photographer's position, there is a 4 ft diameter by 1.5 ft deep depression at the top of the rip rap (which is at about elevation 512, as depicted on sections on Figure 4). About 240 ft south of piezometer 2, behind the photographer's location in Photograph No. 21, there is a wet area at and above the top of the rip rap with a slump in the rip rap. About 360 feet south of piezometer 2, there is a low place in the 525 berm and a wet slope above the rip rap. As discussed later in the Recommendations section 7.2 of this report, geotechnical exploratory work is recommended to evaluate the wet slump area in Photographs 19A and 19B and described above.

The lower portions of the downstream slope (below the top level of the rip rap) were obscured by heavy vegetation in 1996, and this vegetation, not being controlled, had grown by 2001. This vegetation had

been removed in 2006 allowing the rip-rap and rockfill berm to be observed. The rock fill berm (Section BB, Figure 4) at elevation 503 that was observed appeared to be in good condition. The toe of the rockfill berm parallel to the river and the toe of the dike east of the end of the rockfill berm were inspected and no seeps or other features were observed. However, further east (downstream along the river) approaching the outlet of the 36 inch reinforced concrete pipe surface drain that crosses under the basin in the vicinity of the intermediate dike (see Figure 3), the natural river bank is steep and unstable, experiencing shallow slope failures that may affect the dike toe at some time in the future. This problem is even more pronounced along the toe of the secondary basin dike further east (downstream). Table 4-1 summarizes the above mentioned major features observed along the dike facing the Dan River.

Table 4-1
Features on Downstream Slope of Primary Basin
November 14, 2006

Location	Feature
(West and south are same direction along dike) Vicinity of 36" rcp, vicinity of intermediate dike	Natural riverbank is steep and unstable, experiencing shallow slumps that may affect the dike toe in future.
Short distance west of piezometer P-2	Significantly seep emerging midway between rip-rap (elevation 512) and 525 berm
75-80 ft west of piezometer P-2	Depression at top of rip-rap (elevation 512), approx. 4 ft across, 1.5 ft deep (maybe new since 2001).
100 ft west of piezometer p-2	Seepage emerging in rip-rap near top (elevation 512) and above. (Maybe new since 2001).
240 ft west of piezometer P-2	Wet area begins at and above top of rip-rap (elevation 512); slumps in rip-rap (maybe new since 2001).
360-370 ft west of piezometer P-2	Low place in 525 berm; slope wet above top of rip-rap (elevation 512) new since 2001.
South of 48 inch RCP crossing	Slope below 525 berm is wet above top of rip-rap (elevation 512). New since 2001.
Vicinity of Photograph 19A, 19B	Slump has moved since 2001.

Downstream Slope of Secondary Basin
November 14, 2006

Location	Feature
100 ft east of piezometer P-2	Burrow holes at top of rip-rap (elevation 512)
Vicinity of secondary basin pipe outfall (Section F-F on Figure 4)	Natural river bank is steep and active, located nominally 10 ft from toe of dike. May affect dike toe in future.
North of stairs leading to secondary basin pipe outfall	Trees and vegetation still growing in rip-rap.

Photographs No. 22 and No. 23 depict the crest and downstream slopes of the secondary basin dike, adjacent to the Dan River. A good ground cover is established above the top of the rip rap and is well maintained. In 2001, the rip rap was more overgrown than it was in 1996. In 2006, the vegetation had been removed. In 2006, some burrowing activity was noted above the rip-rap in this area. The toe of this dike, along the Dan River, has clear seeps in various locations. Steps leading to the secondary basin pipe outfall, absent in 2001, have since been replaced (Photograph Nos. 23 and 23A). Trees are growing in the rip-rap north of the stairs. A previously mentioned, the natural riverbank along the toe of the secondary basin ash dike is steep and is undergoing sloughing in a number of places, an indication that the riverbank is migrating northerly and may eventually threaten the dike. At the time of the 1996 and 2001 inspections, and the current 2006 inspection, the top of the steep river bank appeared to be within about 10 ft of the secondary basin dike's toe in the vicinity of the secondary discharge tower outlet pipe (Section F-F on Figure 4). On Drawing D-1039-M, dated 1986, the top of the riverbank is indicated (by scaling) to be at least 30 ft from the dike toe.

Further along this toe to the east (or north), a deep gully (leading to the nearby "Railroad Branch" before it enters the Dan River) heads at about the toe of the dike in approximately the middle of the curve forming the northeast corner of the secondary basin; this gully (Photograph No. 28B) appeared the same as it did in 1996 and 2001. There was no change in the appearance of this gully or the dike downstream slope above this gully.

The eastern dike of the secondary basin has a swampy area at and beyond the dike toe (Photograph 28); it could not be determined whether this is due to seepage from the basin or perhaps due to groundwater and surface water collecting in a depression created by construction. No evidence of boils or cloudy water was seen in this area. It was unchanged from its 2001 appearance.

Photographs No. 24 and No. 25 provide views of the discharge tower for the secondary basin. The erosion or wave cutting of the upstream slope of the secondary basin dike observed in 1996 (Photograph 28A) was not observed in 2001 due to vegetation. In 2006, the erosion or wave cutting was again visible. Photograph No. 26 in 2001 provided a view of the discharge pipe for the secondary basin. This viewpoint was not accessible in 2006 due to a higher water level in the Dan River. The steps and platform from which Photographs 26 and 27 of the 1996 inspection were made had been removed at the time of the 2001 inspection. In 2006, the steps leading to the secondary basin pipe outfall had been replaced. The water flowing from this pipe discharges into the Dan River. No depressions or ruts were observed in the basin

dike over the discharge pipe. The water discharging through the pipe appeared clear (Photograph No. 27). However, the concrete pavement of the discharge path was undermined and had eroded some at its edge in 1996. Since 2001, there does not appear to be significant change in the condition of the concrete pavement.

4.2 DRY STORAGE AND DREDGE POND

Photograph No. 29 shows the inlet of the RCP culvert pipe located between the dry basin and primary basin and which conveys surface drainage beneath the primary ash storage basin to the Dan River. This pipe contains an 8 inch tall, 9 inch wide weir. Less than an inch of water was observed flowing through the weir at the time of our observations. The flow into the pipe was clear.

Photographs No. 30 and No. 31 provide views of the dry storage basin dike. This dike contains a good grass cover and shows no signs of instability. A low place in the crest, visible in Photograph 30 and present in 2001, had developed apparently as a result of settlement. Photograph No. 32 is a view of the former dredge pond dike and dredge pond which is currently filled with dry ash. No signs of instability were observed along this embankment; the clear seepage along its toe observed in 1996 was not obvious in 2001 or 2006. The undermined reverse filters observed in the 1996 inspection were not inspected.

5. PREVIOUS INSPECTIONS AND PERTINENT REPORTS

Five previous independent consultant inspections have been performed for this facility, as previously noted. The latter four of these independent reports were reviewed and no indications of serious conditions that would immediately jeopardize the safety of the Dan River Steam Station's dikes were noted.

6. MONITORING INFORMATION

The Dan River Steam Station dikes have been instrumented for frequent monitoring. The current monitoring program relevant to dam safety consists of monthly monitoring of groundwater observation wells, piezometers, and pond elevations. The locations of the monitoring points are depicted on Figure No. 3, and recorded water levels are plotted in Appendix C, of this report. The settlement monuments (M-1 through M-9) on Figure 3 are no longer monitored; yearly readings were discontinued after the February, 1991 readings.

6.1 SETTLEMENT MONUMENTS

A total of nine settlement monuments was present along the dry storage basin dike (See Figure No. 3); these were surveyed annually by Duke Power until the last reading was made in February, 1991. The 1991 inspection report contains the reading of these settlement monuments for 1987-1991. The 1991 report concluded that no apparent settlement had occurred during that time period. Field observations during the previous and this current inspection (2001 and 2006) determined that the crest of the dry ash storage dike shows signs of previous settlement (see Photograph 30) but there is no evidence as to when this settlement took place or whether it is continuing to increase. In this current (2006) inspection, a low place was observed in the elevation 525 berm of the Primary Basin Dike. It is not known if this is related to settlement or subsidence it was not detected in the 2001 inspection.

6.2 PIEZOMETERS

Because the water levels within the piezometers were below the elevations of the seals, the piezometers were functioning as observation wells providing hydrostatic levels rather than piezometric levels. As was noted in the 1986 independent consultant report, the hydrostatic level is generally higher in most embankment dams than the piezometeric surface due to the downward component of seepage flow.

Piezometer readings have been recorded since the last independent inspection in 2001. A review of this data revealed some readings above the design phreatic surface used in the 1984-1985 slope stability analyses. Comparisons of the design phreatic line with the highest recorded water level readings are shown in Table 6-1. Piezometer P-9 was replaced in October, 2001. In original piezometer P-9, no

readings had been recorded since mid 1992. The initial reading of new P-9 at the end of 2001 was 530. The readings in new P-9 increased to 533 in the first quarter of 2002, and then fell back to 530 in mid 2002. Since mid 2002, the readings have gradually increased over time up to about 532.5 in late 2006. The historical high reading of previous P-9 was slightly greater than 534, measured in early 1999. The highest succeeding reading in previous P-9, taken in mid 1991, was 533.3 taken in mid 1991. The analyses water elevations used in the 1997 slope stability analyses are shown in Table 6-1 and also in the plots in Appendix C. We were not furnished the water elevations used in the revised 2005 slope stability analysis at STA 9+01, bit as previously indicated in this report. The 2005 analysis water levels were raised to reflect seepage detected on the downstream slope during an inspection by Duke engineers in September, 2005.

6.3 BASIN WATER LEVELS

The water levels within the basins are recorded along with the piezometer readings. However, since early 2002, primary pond readings have not been recorded at the time piezometer readings were taken. Water levels have sometimes slightly exceeded the maximum stoplog elevation 535 in the primary basin. The maximum water level differential between these primary and secondary basins was recorded as 12.8 feet.

TABLE 6-1

AT	Phreatic Elevations (1997 Analysis)	Phreatic Elevation (1985 Analysis)	Pond Elevation (1985 Analyses) (1997 Analysis)	Highest Piezometric Elevation Since 1991 and Date		Pond Elevation on Same Date	Above (+) or Below (-) 1985 Analyses Phreatic Elevation, ft
P-1	NA	520	527	521.4	9/96	522.2	1.4
P-2	NA	514	527	510.7	2/97	525.5	-3.3
P-3	532	530	535	531.9	2/94	535	-0.1
P-4	526.5	526.5	535	525.7	5/01	Not Available	-0.8
P-5	523.5	523.5	535	521.2	5/01	Not Available	-2.3
P-6[3]	NA	532	535	531.8	8/94	534.9	-0.2[3]
P-7[3]	NA	529.5	535	531	6/03	NA	1.5[3]
P-11	NA	NA[2]	535	530.5	5/01	Not Available	NA[2]
OW-1	NA	NA[2]	535	527.9	8/94	534.8	NA[2]
OW-2	NA	NA[3]	535	532	Mid 2005	Not Available	NA[3]
OW-3	NA	NA[3]	535	529	Early 2006	Not Available	NA[3]
P-9	NA	531	535/525	533.3	5/91[1]	532.7/524.2	+2.3
P-10	NA	528	535/525	530.8	9/95	535/525.3	+2.8

(1) Reading of P-9 was discontinued in mid-1992
(2) P-11 and OW-1 were installed in October, 1986.
(3) OW-2 and OW-3 were installed 10-23-2001; P-6 was replaced 10-23-01; P-7 was replaced 10-23-01.
NA = Not Applicable

The 1997 slope stability analysis of the primary dike (see Section 3.1) takes into account the highest phreatic elevations in Table 6-1. However, due to recently observed slope movement and areas of previously unobserved seepage on the slope emerging 6 to 13 ft below the 525 berm of the Primary Ash Basin along the Dan River, additional geotechnical work and new slope stability analyses are recommended.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

Potentially serious seepage conditions and localized slope movement are present on portions of the downstream slope of the Primary Ash Basin, alongside the Dan River, below the elevation 525 berm. As recommended below, new instrumentation to measure the phreatic surface, coupled with a geotechnical exploration, is needed to assess the severity of the existing conditions with regard to the factor of safety for slope stability of the dike. The other ash basin dikes and the outlet structures at the Dan River Steam Station are in good visual condition. For these other ash basin dikes and outlet structures, there are no obvious signs of imminent instability on deep failure surfaces or serious inadequacy of the project works observed that would require emergency remediation. The instabilities on shallow failure surfaces (slumps or sloughs) noted in the 1996 inspection have been repaired (Photograph 13) or are being monitored.

The existing engineering analyses give an adequate indication of the hydrologic capabilities of the Dan River Steam Station ash dikes. The results of the hydrologic evaluation indicate that the dams meet the criteria established by the Corps of Engineers and the State of North Carolina with regards to hydrologic safety. No further study of the hydrologic safety is warranted at this time.

The maintenance for the project appears to be adequate in terms of its effectiveness, although additional removal of trees and vegetation in rip-rap on the slopes of the secondary dike north of the drainage outlet to the Dan River is recommended below.

Since the 2001 inspection, the program of annual inspections performed by Duke engineers has not been maintained. However, monthly inspections, along with readings of instrument readings, have been performed by plant personnel for most months of 2001, 2002, 2004, 2005 and 2006. Monthly inspections were not performed in 2003. Responsibility for maintaining instrument readings and plotting of data has been assigned to personnel at the individual stations. Previously, this was the responsibility of an individual at Duke's Corporate office with knowledge of previous inspection reports and familiarity with the previous instrument readings. The actual readings themselves, as before, are being taken by local station personnel, currently Mr. Larry Evans, who is responsible for the on-going maintenance of the dikes and outlet works. The plots of the readings had not been made and assessed for their engineering significance as it was unclear who had this responsibility. We recommend that Duke reinstitute more clearly defined engineering responsibility for the receiving and plotting of data from the dikes at the

individual stations, in order to ensure that the data are plotted on a regular basis to facilitate engineering evaluation of any changes requiring attention prior to the 5 year inspections. The annual inspections by Duke engineers should also be reinstated and the plotted instrument readings up to the time of each annual inspection used to help evaluate any changes noted in the annual inspections.

7.2 RECOMMENDATIONS

1. Monthly monitoring of basin level and piezometer/observation wells should be continued.

2. The former wet area in the slope above the access road (see caption of Photograph 8) should be visually monitored. The railroad subgrade repair undertaken in May 2001 appeared to have dried up this area, but it has now apparently returned.

3. The vegetation in the valley under the sluice pipes, created by the primary basin dike and the adjacent plant roadway, should continue to be kept cleared enough to allow observation of the ground surface in this area so that the water flowing into the valley can be observed for turbidity and removal of materials.

4. The outflow of the drainage pipes extending under the primary ash basins to the river should be monitored for turbidity of the discharge, which would be indicative of soil entrance into the pipes through leaks under the basin. The appearance of turbidity would make it advisable to perform a TV camera inspection of the pipe to help determine if the leak or leaks are a threat.

5. The slump in the slope below the elevation 525 berm on the southern embankment of the primary ash basin. (See Photographs 19A and 19B) facing the river has shown continued movement, along with seepage on the slope. This fresh movement and appearance of seepage in this slump and elsewhere along this slope are cause for an engineering investigation, including a soil test boring made on the elevation 525 berm for SPT and UD soil samples for laboratory testing and fitted with piezometers and/or an observation well. Also, we specifically recommend two additional borings with undisturbed samples for lab testing and installation of observation wells be performed on the 525 berm at seepage areas located about 80 ft south and 240 ft south of Piezometer No. 2.

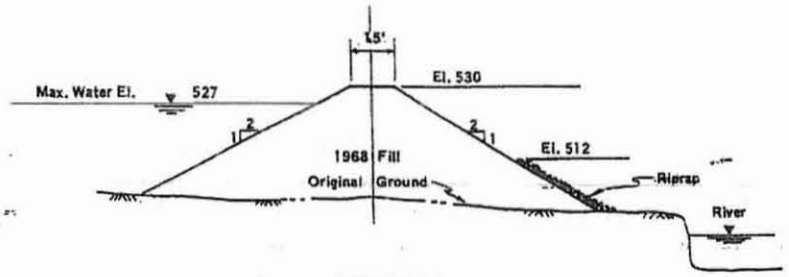
6. In the 2001 report, it was recommended that the vegetation (small trees, vines, briars, etc.) growing in the rip rap on the slope of the embankments for the primary and secondary ash basins facing the Dan River should be cleared before late February, 2002. In 2006, this vegetation had

been mostly controlled and both the rip-rap (elevation 512) and rockfill berm (elevation 503) were visible for inspection. However, trees are growing in the rip rap north of the secondary basin stairs down to the Dan River and need similar removal. Vegetation in the rip rap should be controlled at least biannually using an appropriate herbicide. The grass cover on the slope above the rip rap should continue to be maintained with mowing at least twice yearly all the way down the slope to the top of the rip rap.

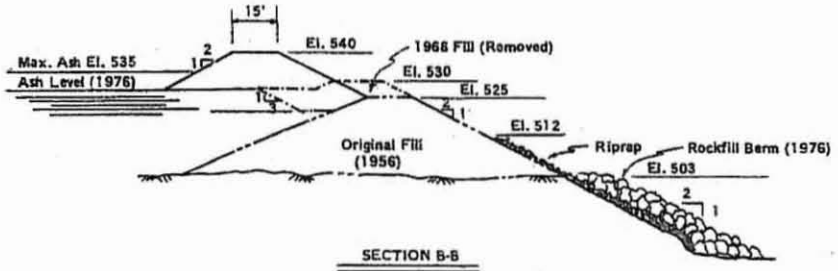
7. The seepage along the toe of the southern dike for the secondary ash basin should be kept under observation during the yearly inspections for signs of increase in volume of erosion and slumping as the investigation in recommendations number 5 is completed and beyond.

8. As was noted in 2001, the steep river bank of the Dan River parallel to the toe of the eastern end of the primary ash basin dike and along all of the secondary ash basin dike appears to be unstable and possibly migrating toward the toe of the dikes. It does not appear that the condition in 2006 is much different than in 2001. This indicates that the process is slow enough that its progress will likely not be detected in time to take remedial action unless a monitoring program is put in-place. Such a program would include, as a minimum, placing reference monuments beginning at the toe and at 5 ft spacing out to the river bank in a line perpendicular to the dike crest. During the annual inspections, the position of the top of the riverbank would be carefully documented by reference to these monuments. Such lines of monuments should be installed in at least two locations in the eastern part of the primary basin dike and at least three locations along the secondary basin dike.

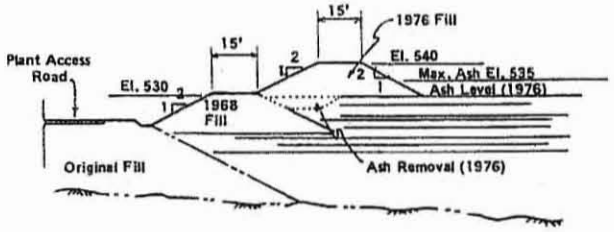
9. Recent ground hog activity was noted at several locations above the riprap on the downstream slope of the Secondary Ash Basin dike, along the Dan River. Burrowing animals such as groundhogs should continue to be controlled to the maximum extent practical. Maintenance of the present good grass cover with mowing two to three times per year, as is presently being done, will help discourage burrowing activity by denying the animals protective cover.



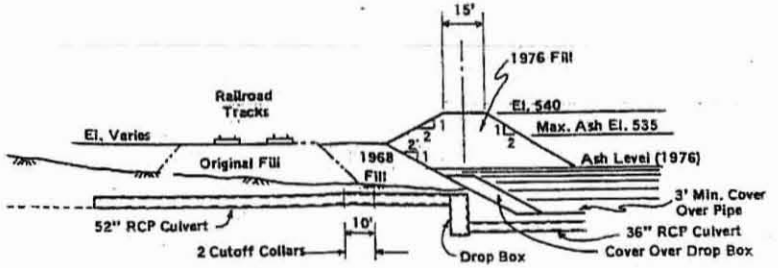
SECTION A-A



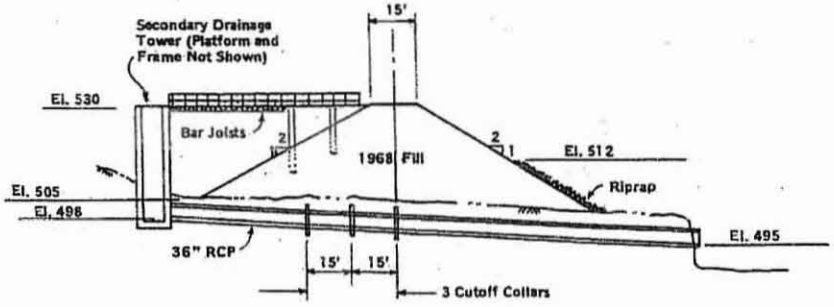
SECTION B-B



SECTION D-D



SECTION E-E



SECTION F-F

NOTE: SEE DRAWING 3 FOR LOCATION OF SECTIONS

REF.: DUKE POWER COMPANY DRAWING NO. D-1039-J, LATEST REVISION DATED 7-13-76.

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SECTIONS THROUGH PRIMARY AND SECONDARY DIKES
DAN RIVER ASH STORAGE BASINS
EDEN, NORTH CAROLINA

PREPARED BY	DATE	CHECKED	DATE
[illegible]	2-19-07	MYB	2-19-07
JOB NO. 6234-06-3908		FIGURE	4

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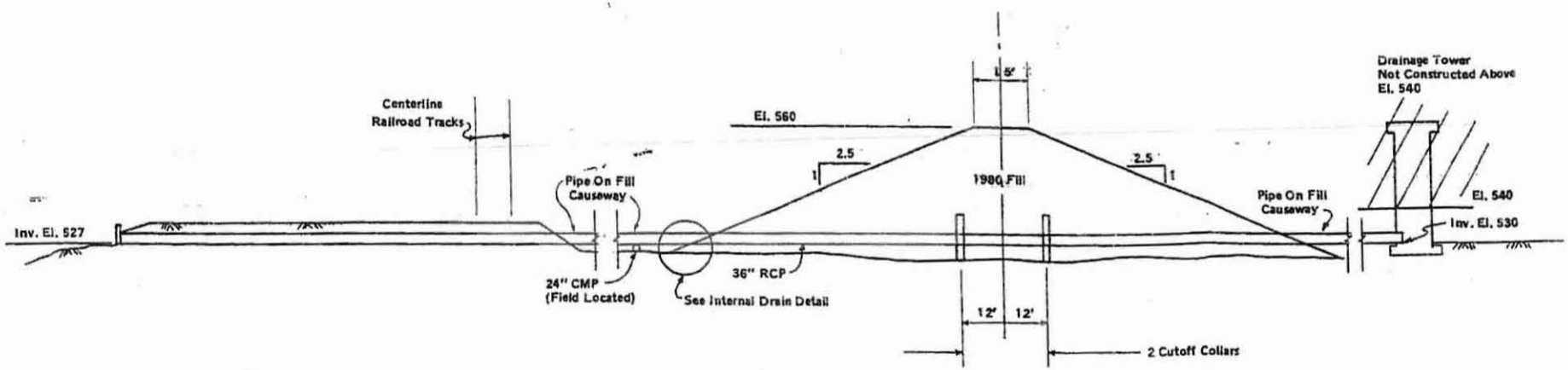
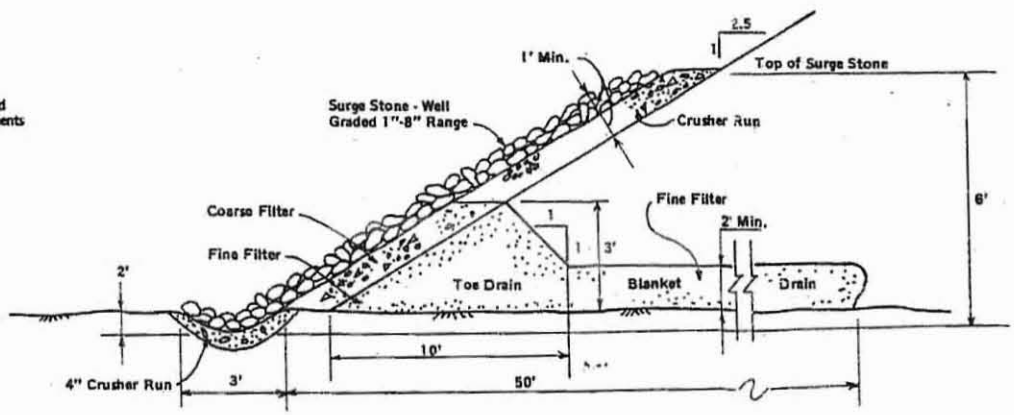


SECTION G-G

NOTE: SEE DRAWING 3 FOR LOCATION OF SECTION G-G



Note: Blanket Drain to Extend Up to El. 530 on Abutments

TYPICAL INTERNAL DRAIN DETAILS

REF.: DUKE POWER COMPANY DRAWING NO. D-1039-M-1, LATEST REVISION DATED 11-7-80.

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TYPICAL SECTION AND DETAILS DRY STORAGE BASIN DIKE AND OUTLET

DAN RIVER ASH STORAGE BASINS
EDEN, NORTH CAROLINA

PREPARED BY MRH	DATE 2-19-07	CHECKED MTD	DATE 2-19-07
JOB NO. 6234-06-3908		FIGURE	5

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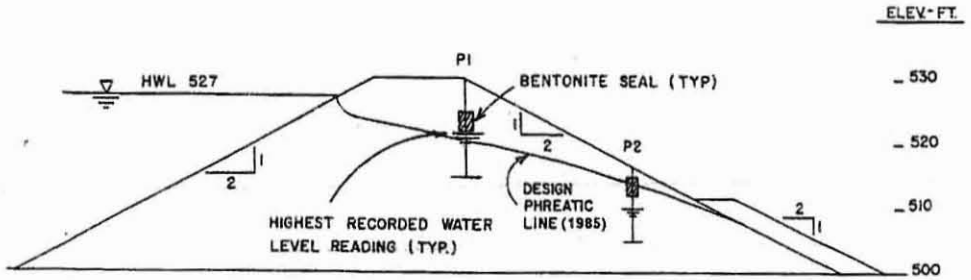
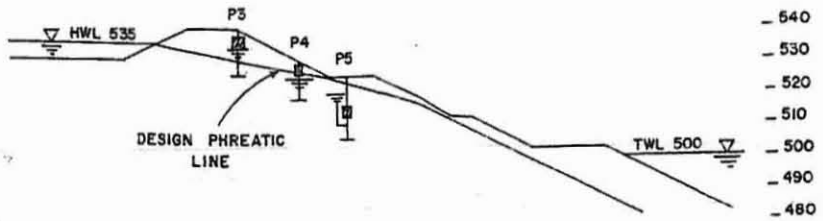
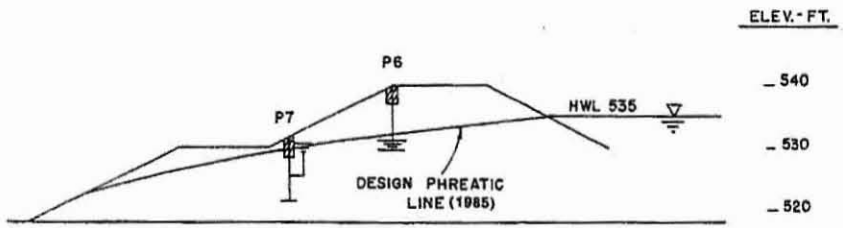


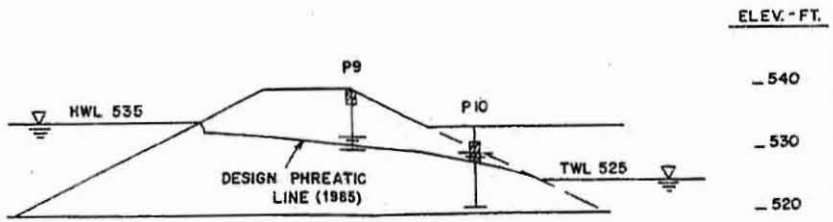
SECONDARY BASIN DIKE



PRIMARY BASIN DIKE
(NEXT TO RIVER)



PRIMARY BASIN DIKE
(NEXT TO PLANT ACCESS ROAD)



INTERMEDIATE DIKE
(NEW BERM NOT SHOWN)

NOTE: 2006 INSPECTION SHOULD ADD A SECTION CONTAINING OW2 AND OW3.

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PIEZOMETER READINGS AT SELECTED
SECTIONS OF DAN RIVER ASH BASIN DIKES
DAN RIVER ASH STORAGE BASINS
EDEN, NORTH CAROLINA

PREPARED BY	DATE	CHECKED	DATE
MLH	2-19-07	MTB	2-19-07

JOB NO. 6234-06-3908 FIGURE 7

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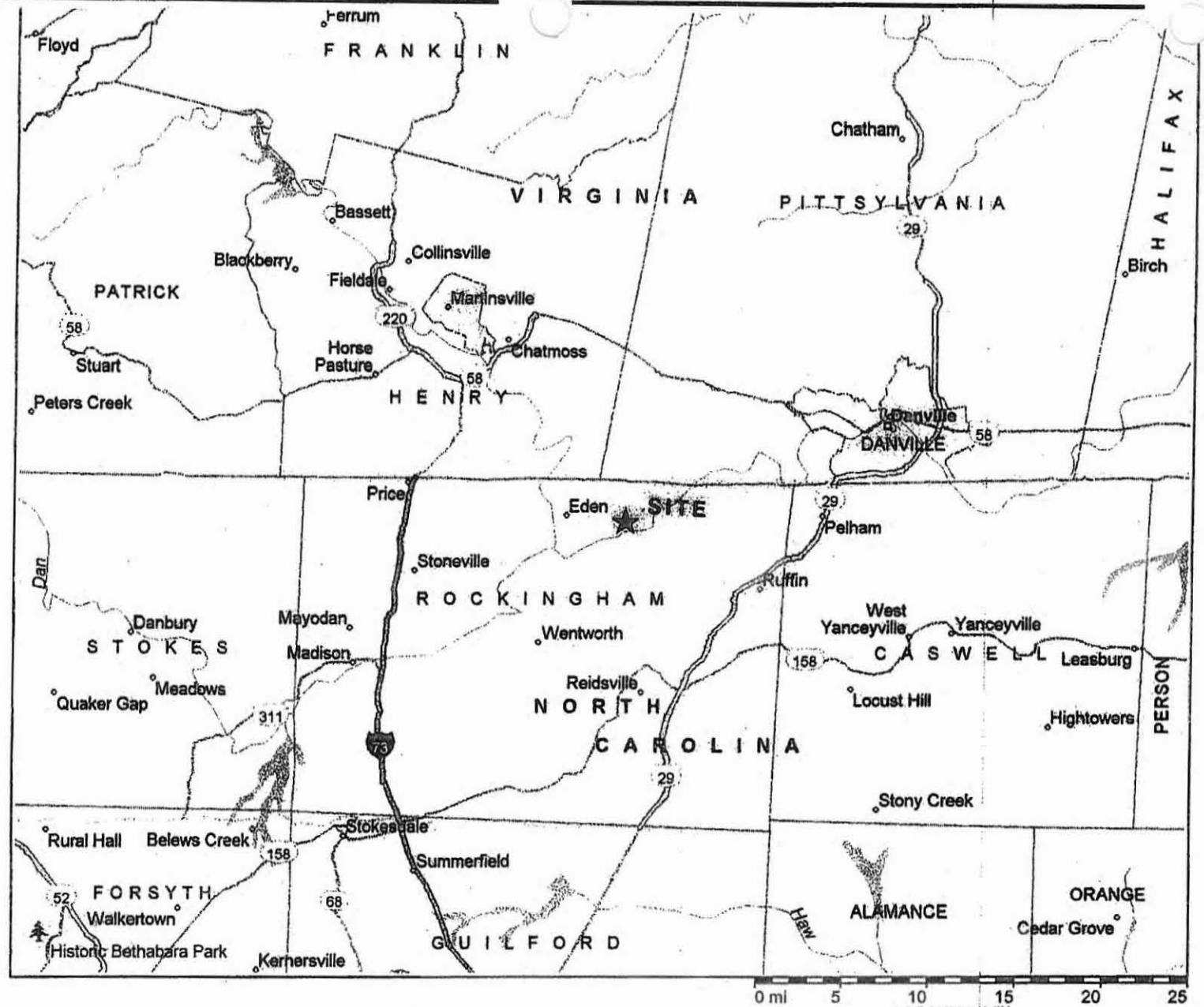
APPENDIX A



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VICINITY MAP
DAN RIVER STEAM STATION
EDEN, NORTH CAROLINA

PREPARED BY	DATE	CHECKED	DATE	JOB NO.	FIGURE
	2-19-07	MTB	2-19-07	6234-06-0908	1

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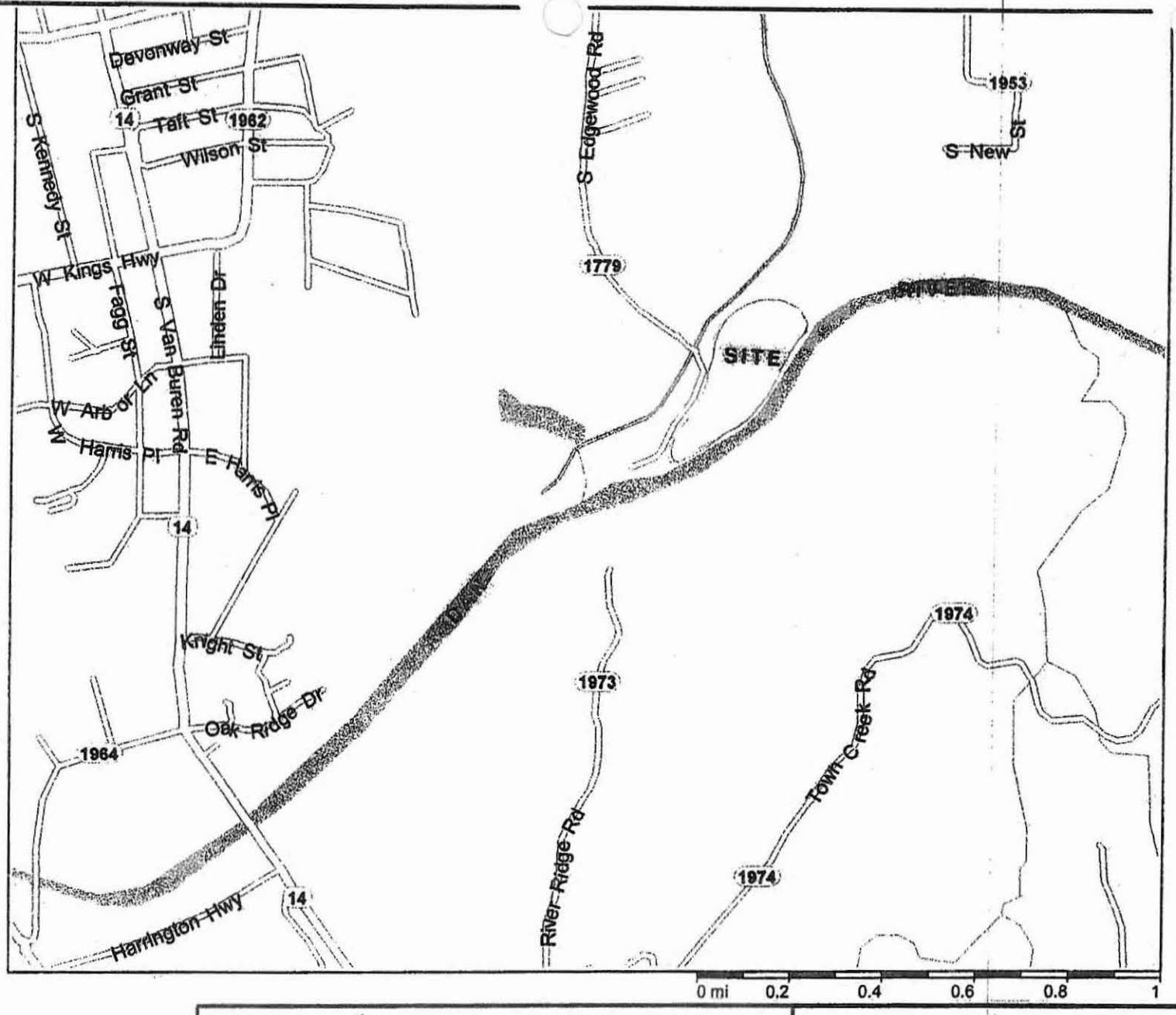

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SITE LOCATION
DAN RIVER STEAM STATION
EDEN, NORTH CAROLINA

PREPARED BY	DATE 2-19-07	CHECKED MTB	DATE 2-19-07	JOB NO. 6234-06-0908	FIGURE 2

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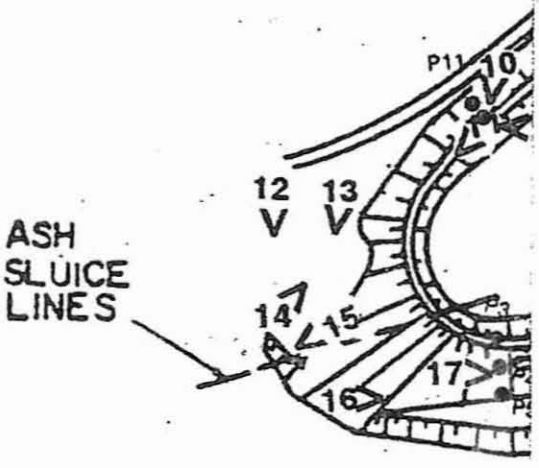

LEGEND

8> - Indicates Number And Direction Of Photographs In Appendix B

△ - Settlement Monument

● - Piezometer

NOT TO SCALE

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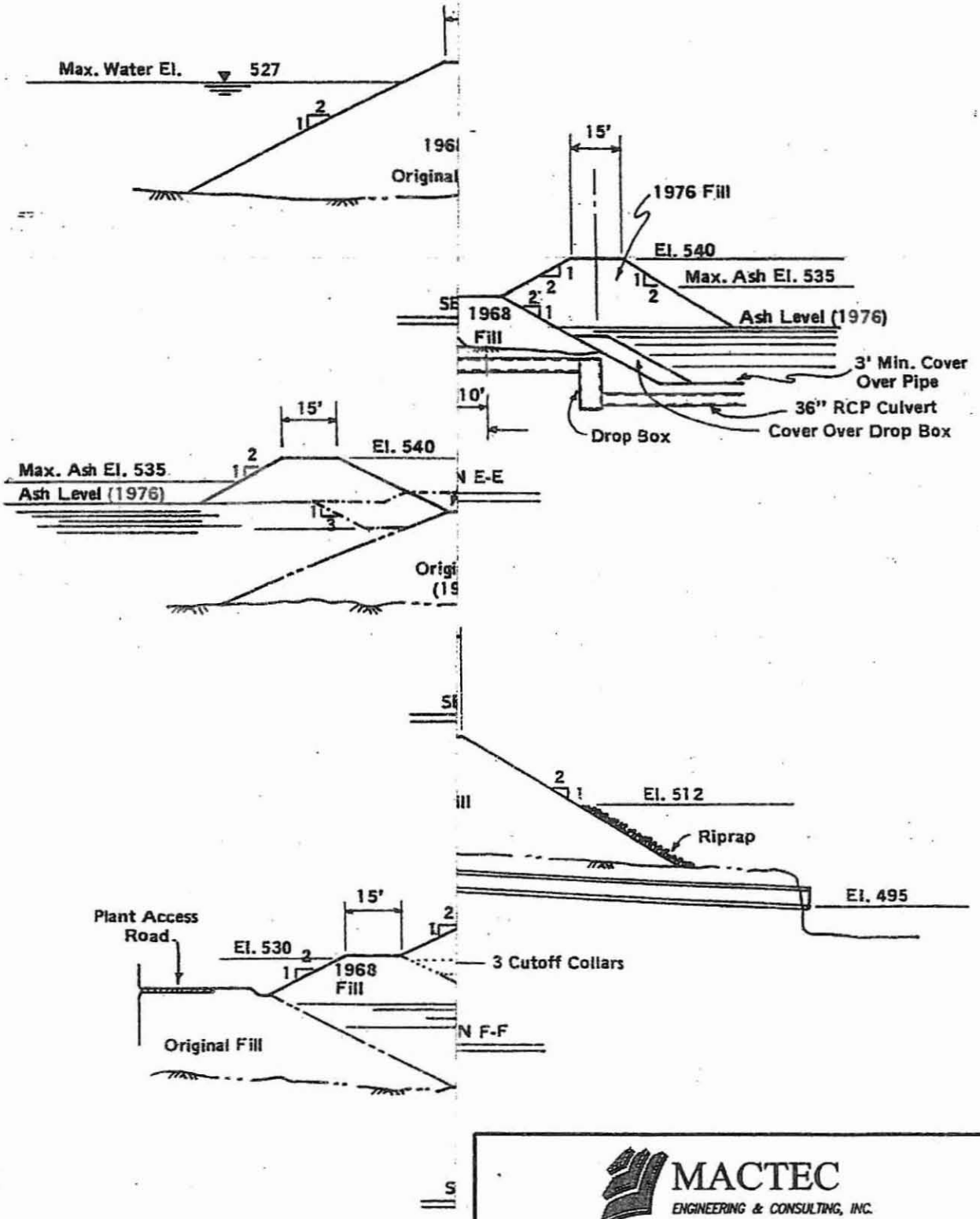
PROJECT LAYOUT

DAN RIVER ASH STORAGE BASINS
EDEN, NORTH CAROLINA

PREPARED BY	DATE	CHECKED	DATE
	2-19-07	MTB	2-19-07
JOB NO. 6234-06-3908		FIGURE	3

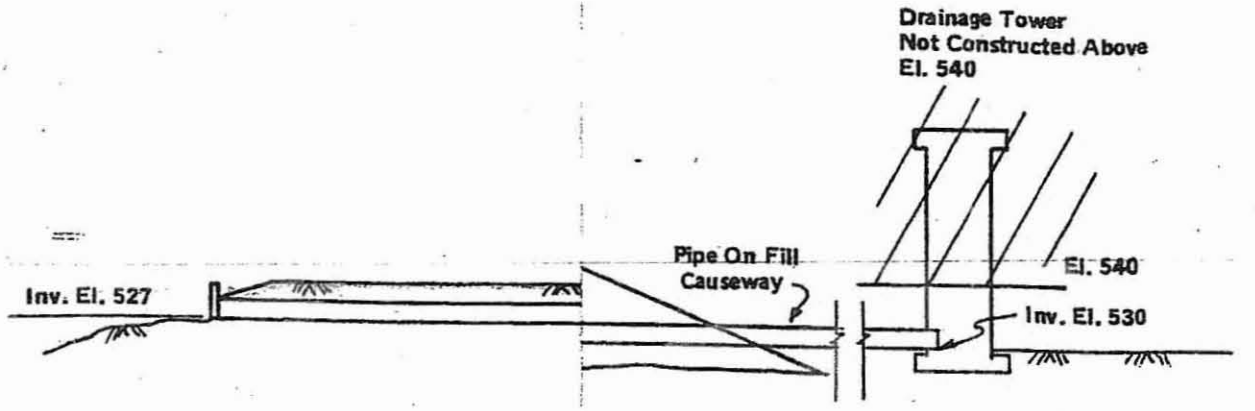


MACTEC
ENGINEERING & CONSULTING, INC.
CHARLOTTE, NORTH CAROLINA

SECTIONS THROUGH PRIMARY AND SECONDARY DIKES
DAN RIVER ASH STORAGE BASINS
EDEN, NORTH CAROLINA

PREPARED BY	DATE	CHECKED	DATE
	2-19-07	MTB	2-19-07

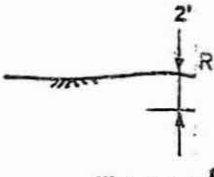
JOB NO.	FIGURE
6234-06-3908	4



ɔilars

G 3 FOR LOCATION OF SECTION G--G

Note: Blanket Drain to Extend
Up to El. 530 on Abutments



REF.: DUKE POWER COMPANY DRAWING NO. D-1039-M-1, LATEST REVISION DATED 11-7-80.

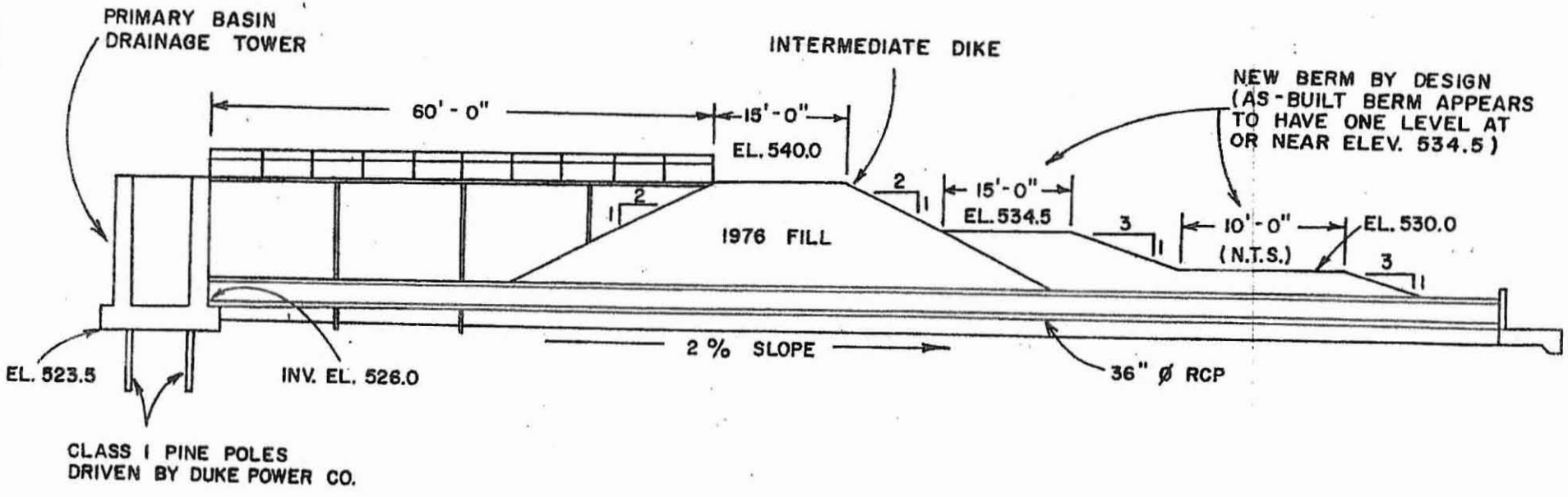
MACTEC
ENGINEERING & CONSULTING, INC.
CHARLOTTE, NORTH CAROLINA

TYPICAL SECTION AND DETAILS DRY STORAGE BASIN DIKE AND OUTLET

DAN RIVER ASH STORAGE BASINS
EDEN, NORTH CAROLINA

PREPARED BY	DATE	CHECKED	DATE
MRH	2-19-07	MTB	2-19-07

JOB NO.	FIGURE
6234-06-3908	5



SECTION H–H

(SEE DRAWING 3 FOR LOCATION)

MACTEC
ENGINEERING & CONSULTING, INC.
CHARLOTTE, NORTH CAROLINA

SECTION AT PRIMARY BASIN OUTLET
DAN RIVER STEAM STATION
EDEN, NORTH CAROLINA

PREPARED BY	DATE	CHECKED	DATE	JOB NO.	FIGURE
	2-19-07	MTB	2-19-07	6234-06-0908	6

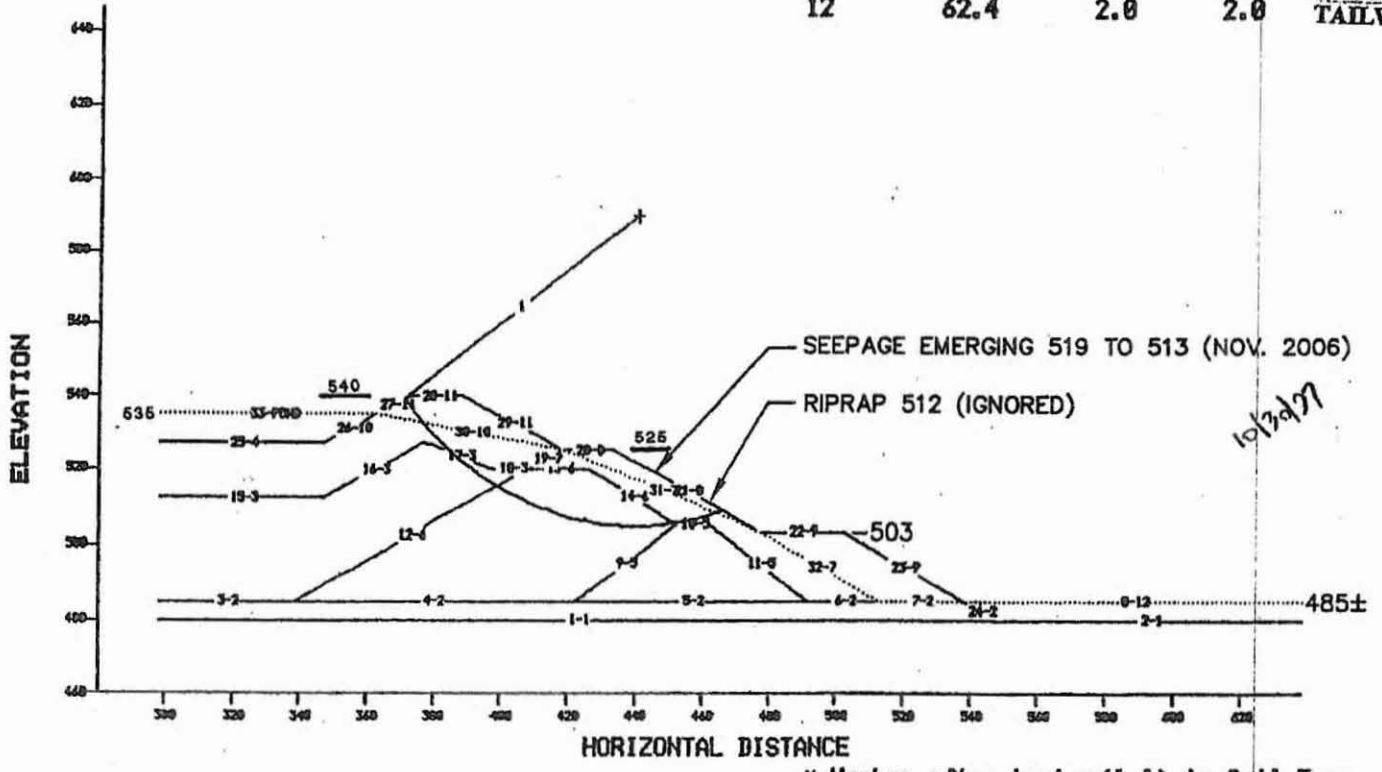
SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Steady State Seepage
LOCATION: Dan River Steam Station
FILE: DRPD0901
PARTIAL SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	440.0	590.0	85.4	1.45

SOIL*	DENSITY	COHESION	PHI	MATERIAL
1	140.0	1000.0	35.0	PWR
2	125.0	800.0	28.0	FOUNDATION
3	90.0	0.0	30.0	CONSOLIDATED ASH
4	90.0	0.0	16.0	ASH
5	122.0	700.0	27.0	1954 FILL
6	90.0	0.0	30.0	CONSOLIDATED ASH
7	122.0	700.0	27.0	1956 FILL SATURATED
8	118.0	700.0	27.0	1956 FILL
9	125.0	0.0	33.0	RIP-RAP
10	123.0	0.0	33.0	1976 FILL SATURATED
11	119.0	0.0	33.0	1976 FILL
12	62.4	2.0	2.0	TAILWATER



* Number after hyphen('-') is Soil Type

Duke Power Company - Design Engineering Department

MACTEC
ENGINEERING & CONSULTING, INC.
CHARLOTTE, NORTH CAROLINA

1997 STABILITY ANALYSIS
DAN RIVER STEAM STATION
SECTION AT STATION 9+01 (P-3,P-4,P-5)

PREPARED BY	DATE	CHECKED	DATE	JOB NO.	FIGURE
	2-19-07	MTB	2-19-07	6234-06-3908	8

APPENDIX B

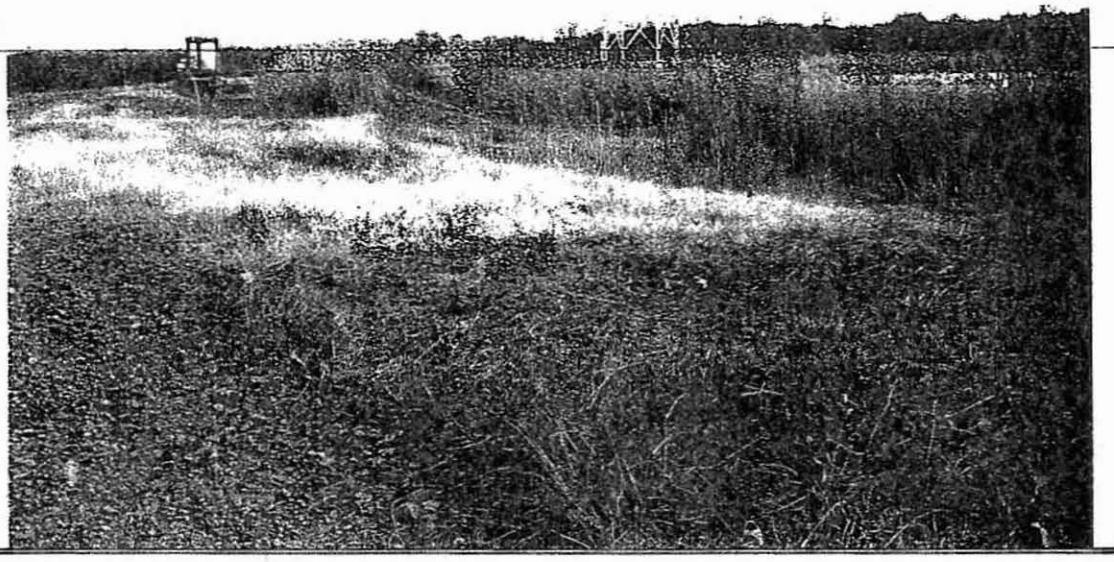
Photograph Nos. 1 Through 32, Plus 8A, 19A, 19B, 23A, 28A and 28B

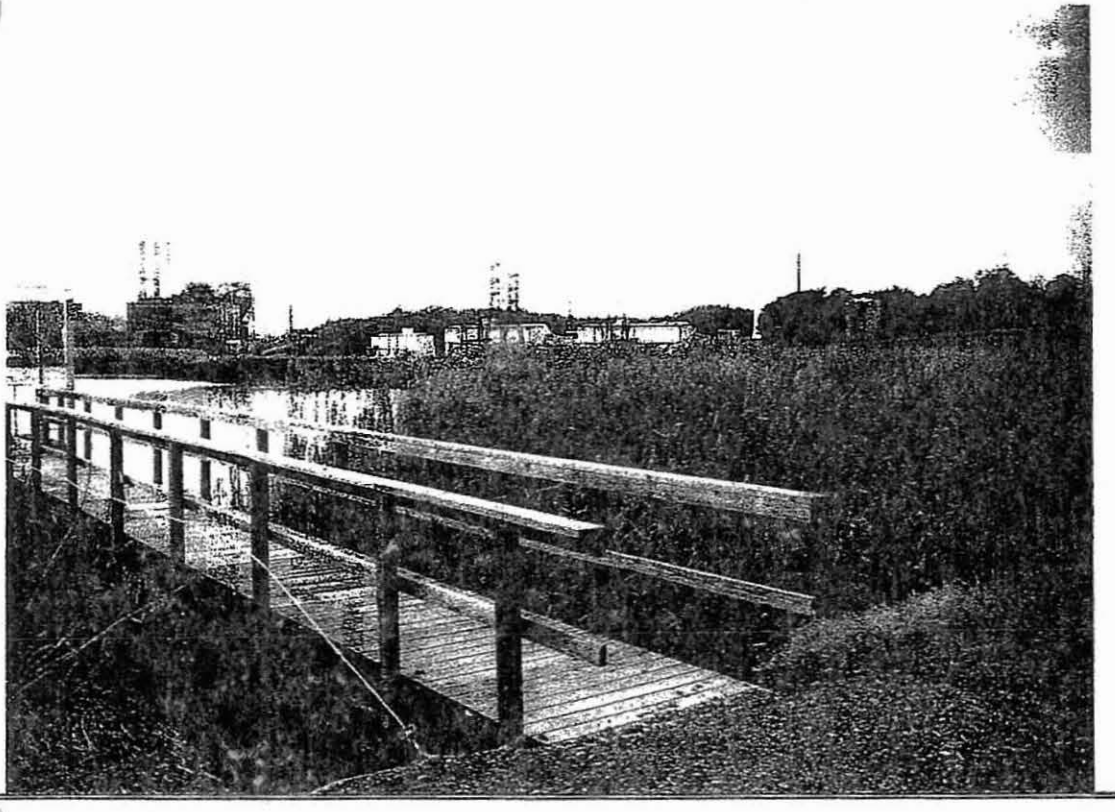
	Remarks
	**Photograph 1** Intermediate dike S-SE view. Note minor depression (no ponding) in wheel tracks seen beyond walkway to discharge tower. Metal tower constructed since 2001.

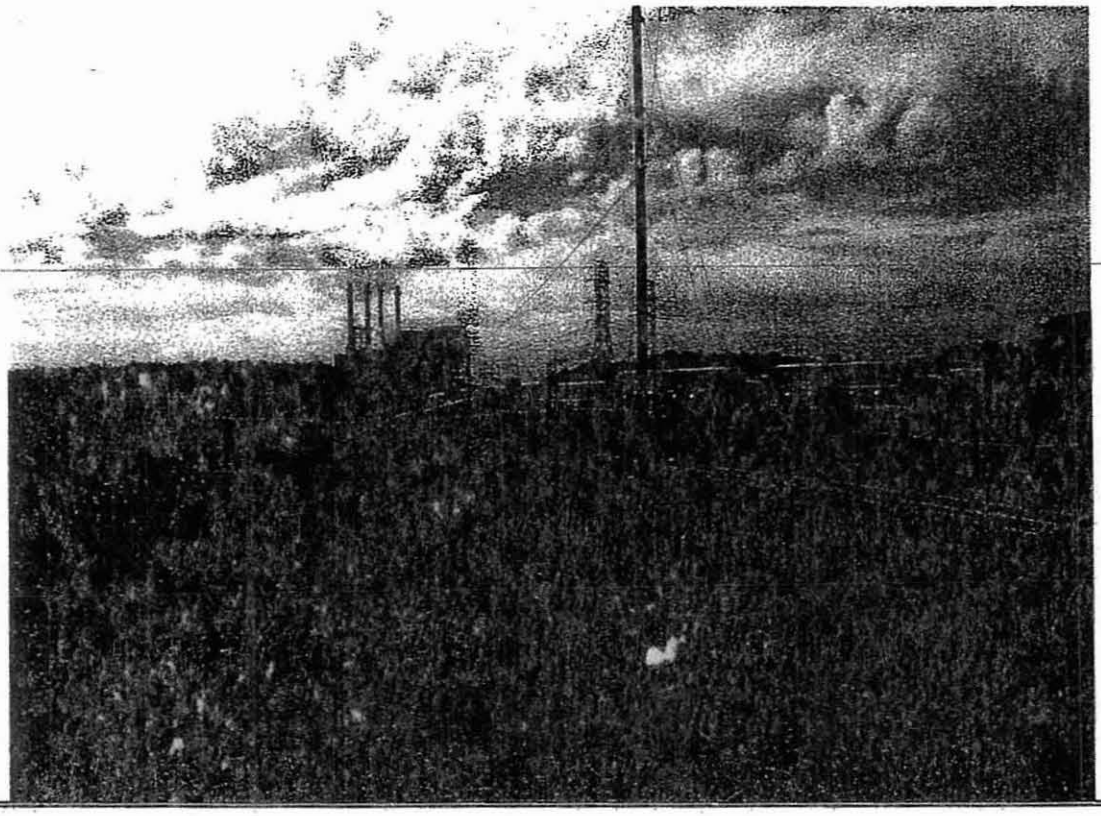
	Remarks
	**Photograph 2** Upstream slope of intermediate dike S-SE view. Steep slope begins about 6 ft below crest elevation. Some depressions in wheel tracks.

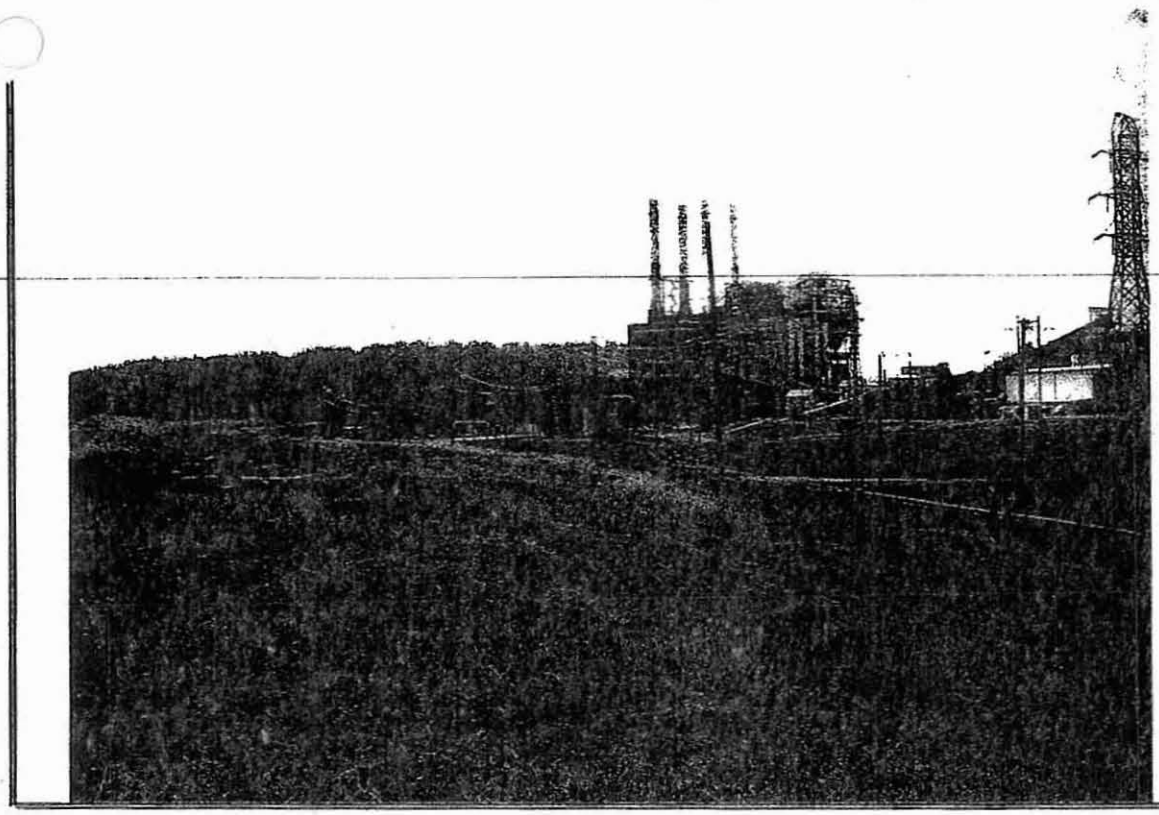
	Remarks
(No 2006 photograph)	**Photograph 3** Downstream slope of intermediate dike N-NW view. See 2001 photograph.

	Remarks
	**Photograph 4** Downstream slope of intermediate dike rock fill berm N-NW view. Small bushes beginning to grow in rock fill in 2001 have been removed.

	Remarks
	**Photograph 5** Primary ash basin discharge tower

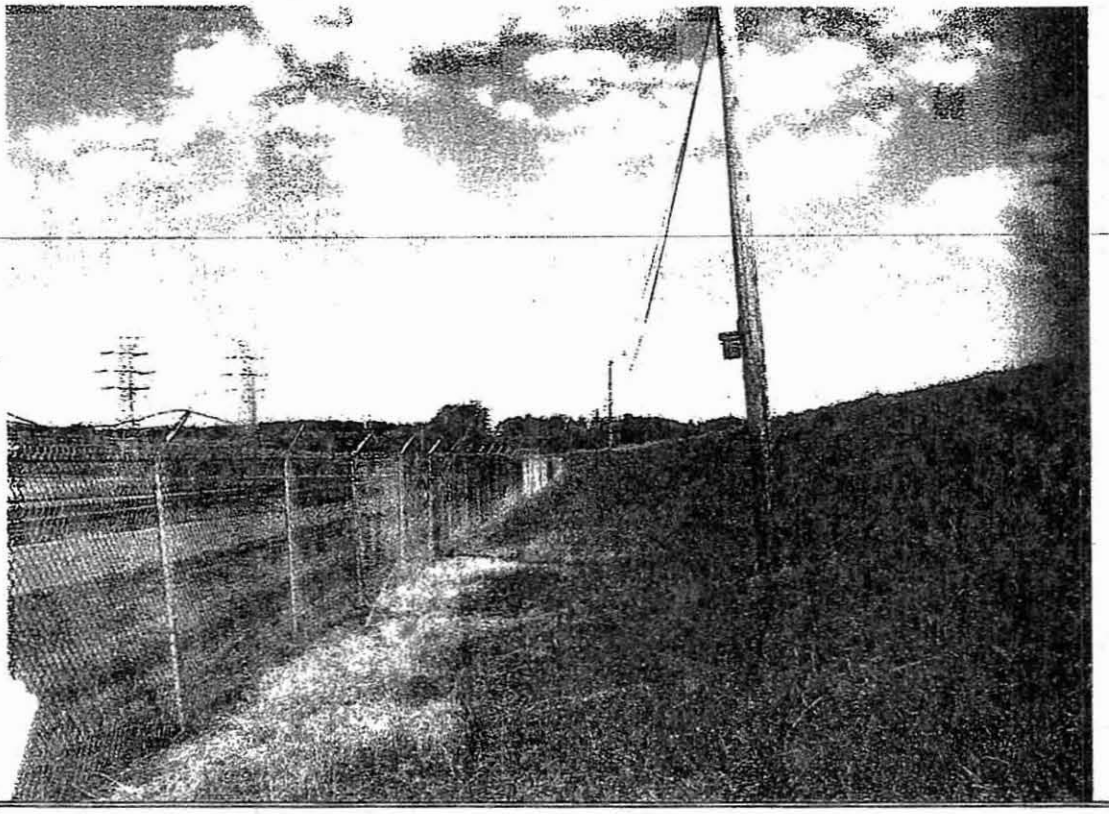
	Remarks
	**Photograph 6** Access ramp to discharge tower, replaced since 2001.

	Remarks
	**Photograph 7** Crest of north dike for primary basin, facing plant.



Remarks
Photograph 8 North dike, facing plant. Slope was wet above access road in 1996; was dry in 2001. Slope "notch" by access road maintenance in 1996, corrected by 2001, now reappears higher above road. Some seepage emerges at base of road slope.

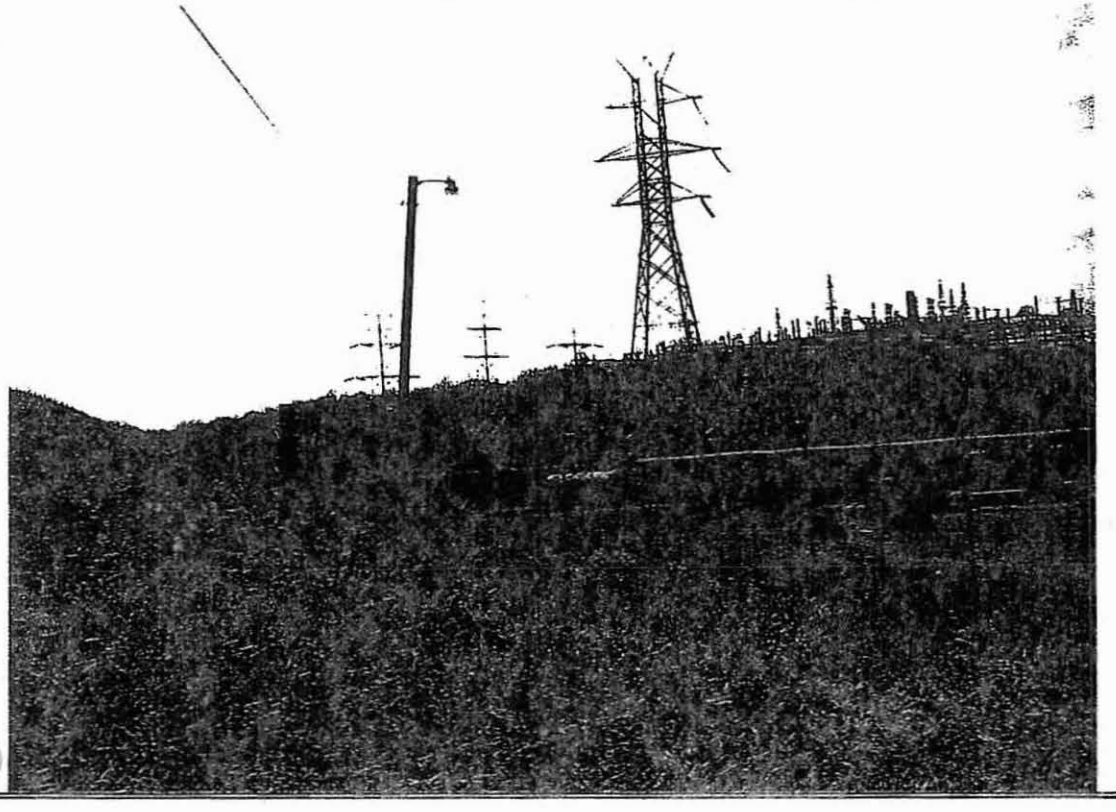
Remarks
Photograph 8A Railroad area repaired to correct wet subgrade conditions in May 2001. North Dike, facing away from plant, visible to right side of Photograph. Access road heading to dike crest and mentioned in Photograph No. 8 is visible.



Remarks

Photograph 9

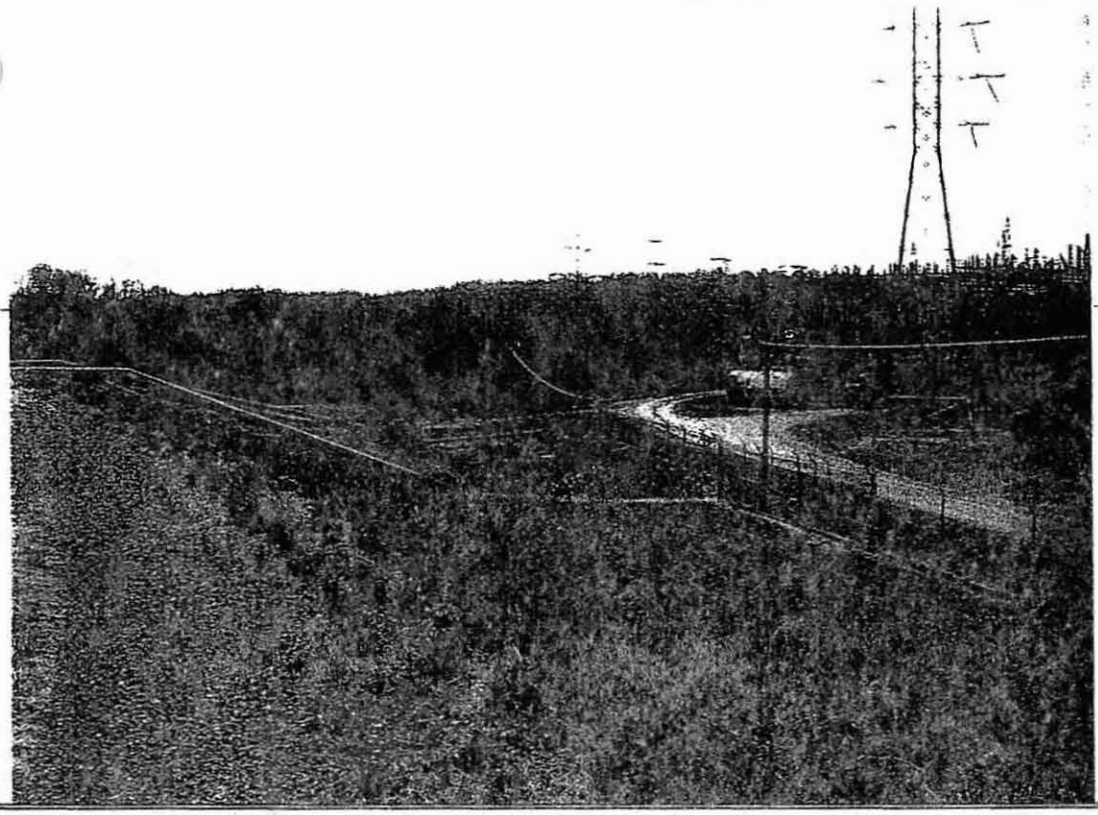
Downstream slope of northern embankment with Piezometers 6 and 7 in background. Pole 77 closest to Photographer. Poles lean in same direction as in 2001. Poles loose in embankment. Road ditch (outside chain link fence in left side of Photograph) is wet with ponded seepage, consistent with high phreatic line in P-6 and P-7. A minor wet pothole on the crest road was observed near P-6.

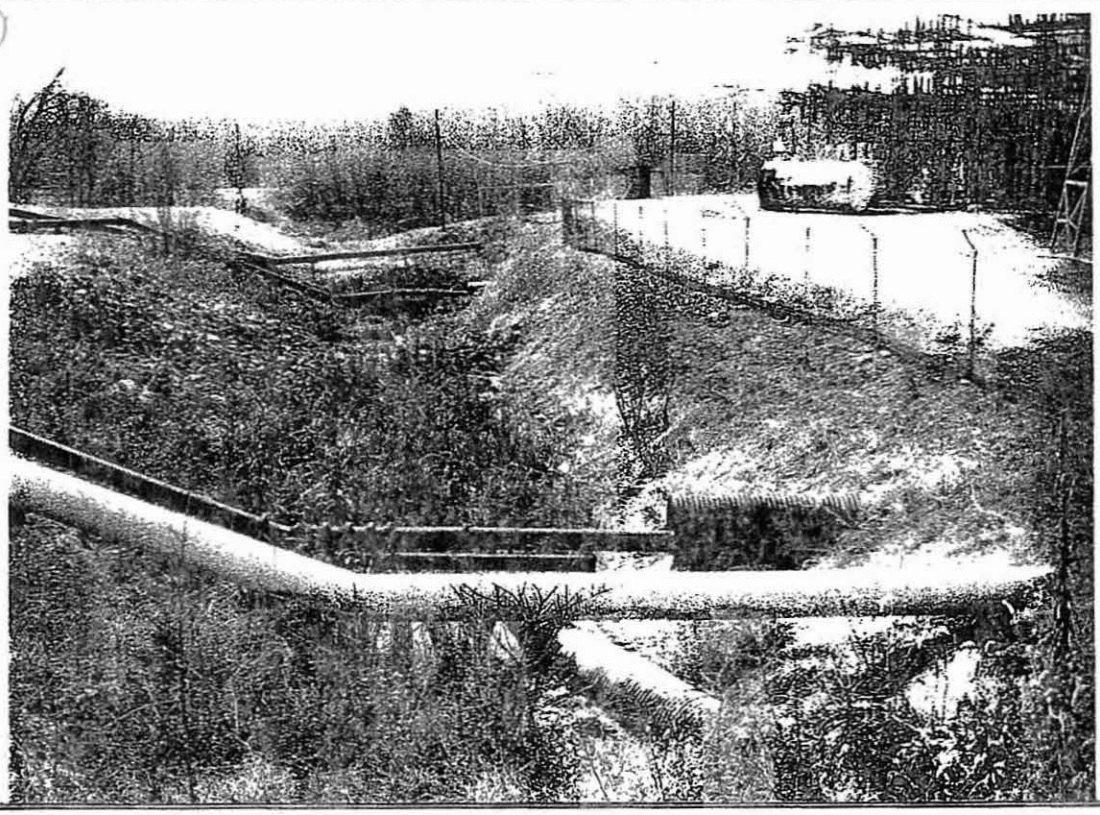


Remarks

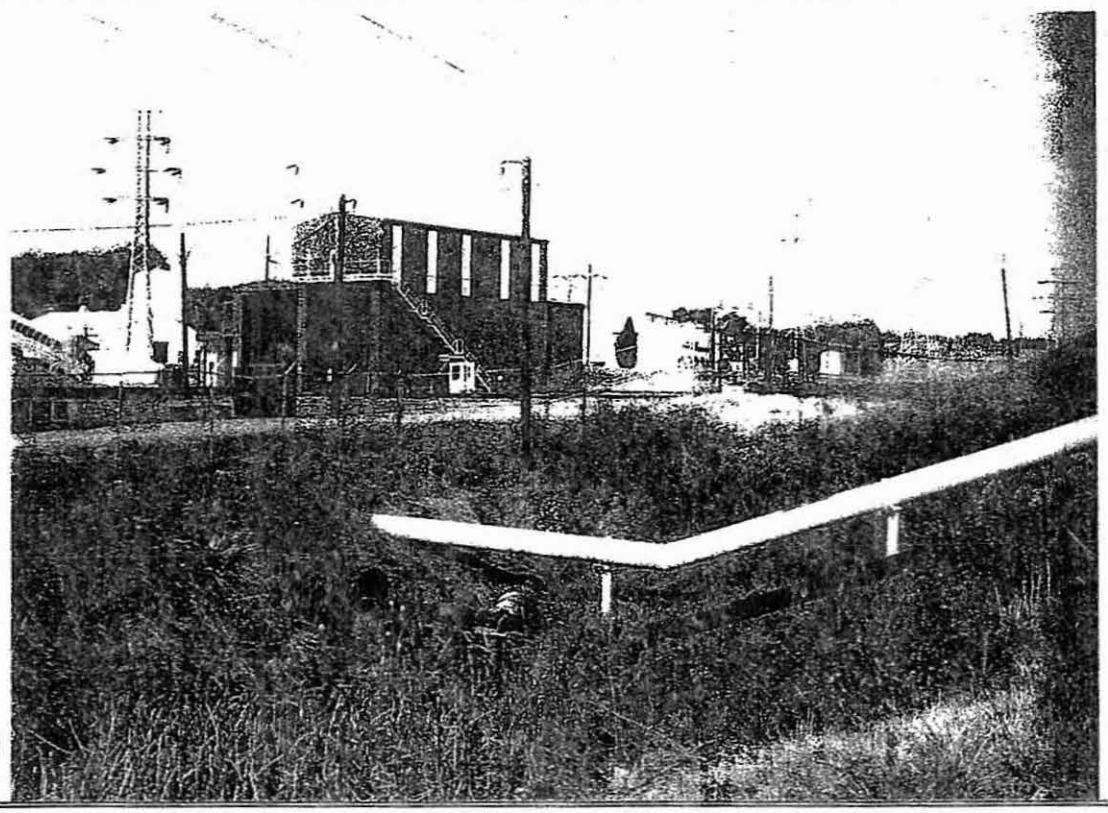
Photograph 10

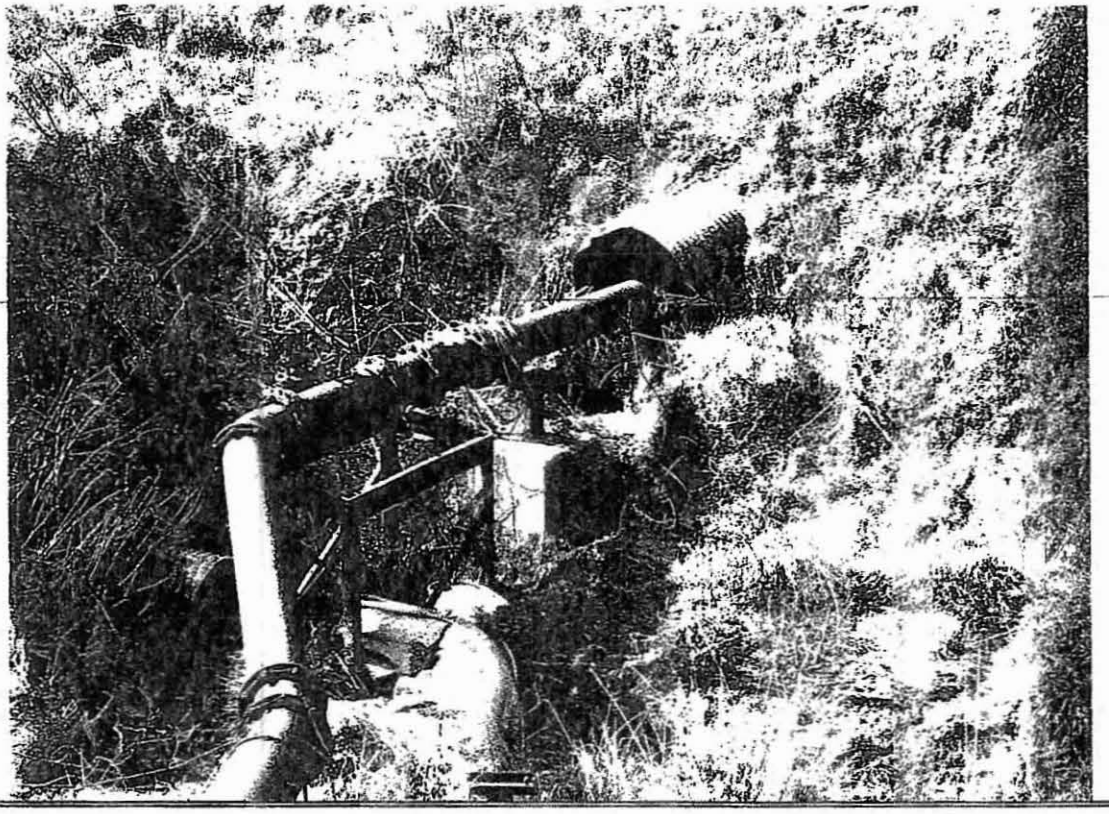
Downstream slope of north embankment with piezometer 11. Pole leans about the same as in 2001. Road ditch outside fence to right in Photograph is wet from seepage.

	Remarks
	**Photograph 11** Crest and downstream slope of primary basin dike.

	Remarks
	**Photograph 12** Sluice pipes, facing south. Groundhog burrow observed on slope, left side, beyond rock fill.

	Remarks
	**Photograph 13** Next to Photograph No 12 slightly to the left going up the embankment. Wet slump visible in Embankment in 1996 was repaired in 2001 (see rock fill area). Slope still appears stable.

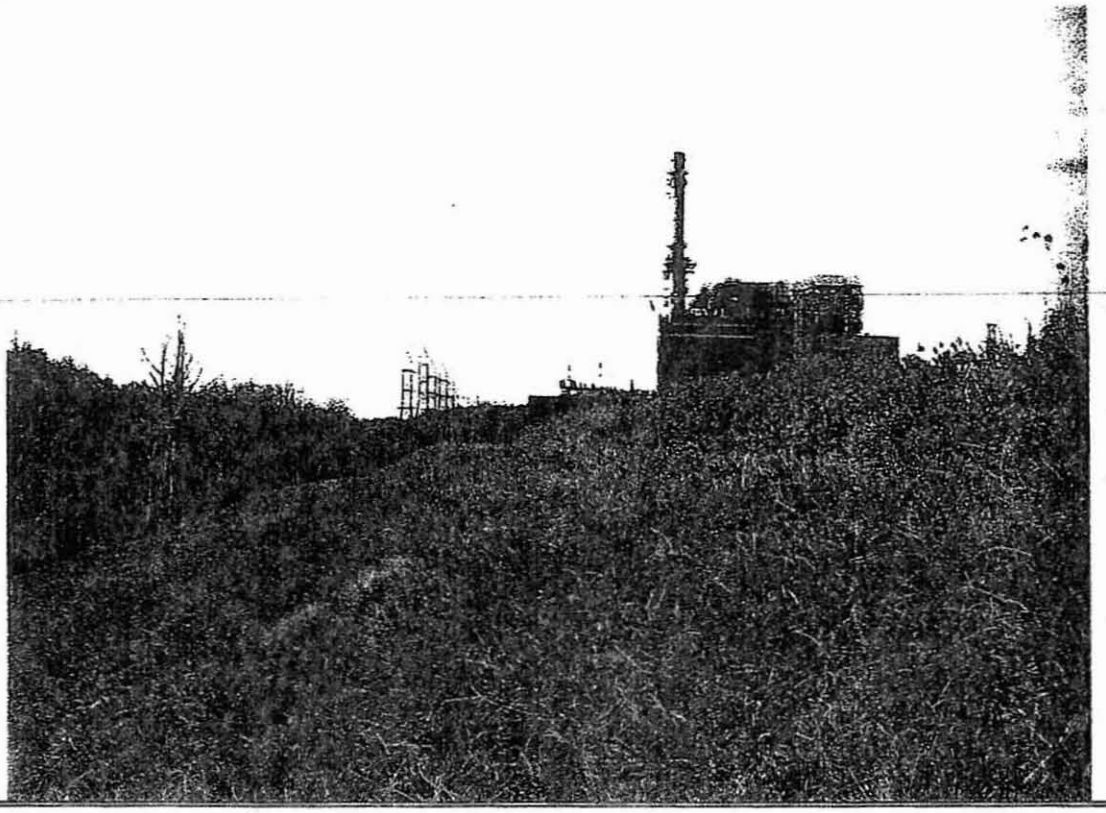
	Remarks
	**Photograph 14** Valley between access road and toe of dike.

	Remarks
	**Photograph 15** Valley facing west. Piping may have been realigned at bottom of picture since 2001.

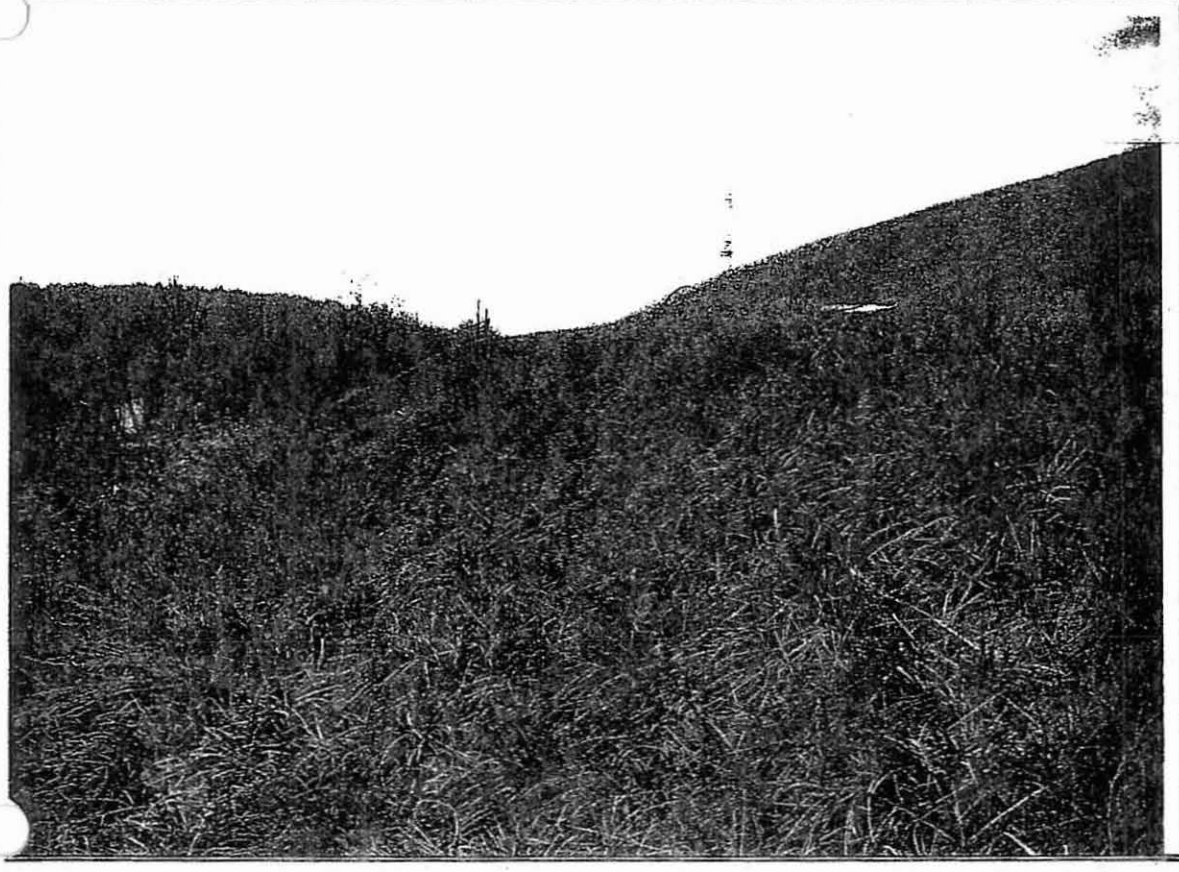
	Remarks
	**Photograph 16** Downstream slope of southern section of primary basin adjacent to Dan River. No groundhog burrows observed in this area.

	Remarks
	**Photograph 17** Downstream slope of primary basin dike adjacent to Dan River.

	Remarks
	**Photograph 18** Crest of southern embankment for primary ash basin.



Remarks
Photograph 19 Crest of southern embankment for primary ash basin, facing power plant. The slump in photographs 19A and 19B is located about 150 ft east (behind photographer) from the slight bend in the dike alignment.



Remarks
Photograph 19A Slump in slope below elevation 525 berm looking S-SW. Slump has moved since 2001.

Remarks

Photograph 19B

Slump in slope below elevation 525 berm looking N-NE. Slump has moved since 2001.

Remarks

Photograph 20

Downstream slope of primary basin facing N-NE adjacent to Dan River. Photographer was standing approximately 900 ft south of piezometer P-2.

Remarks

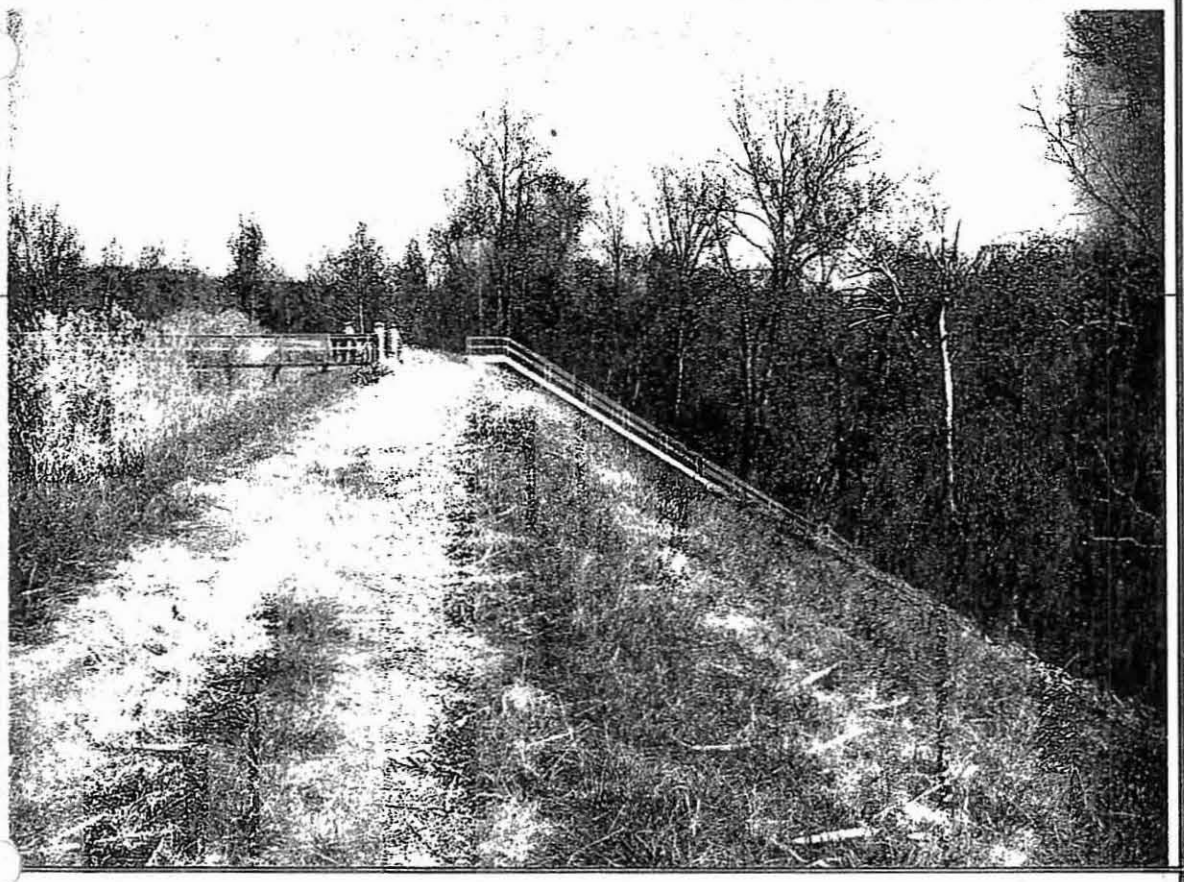
Photograph 21

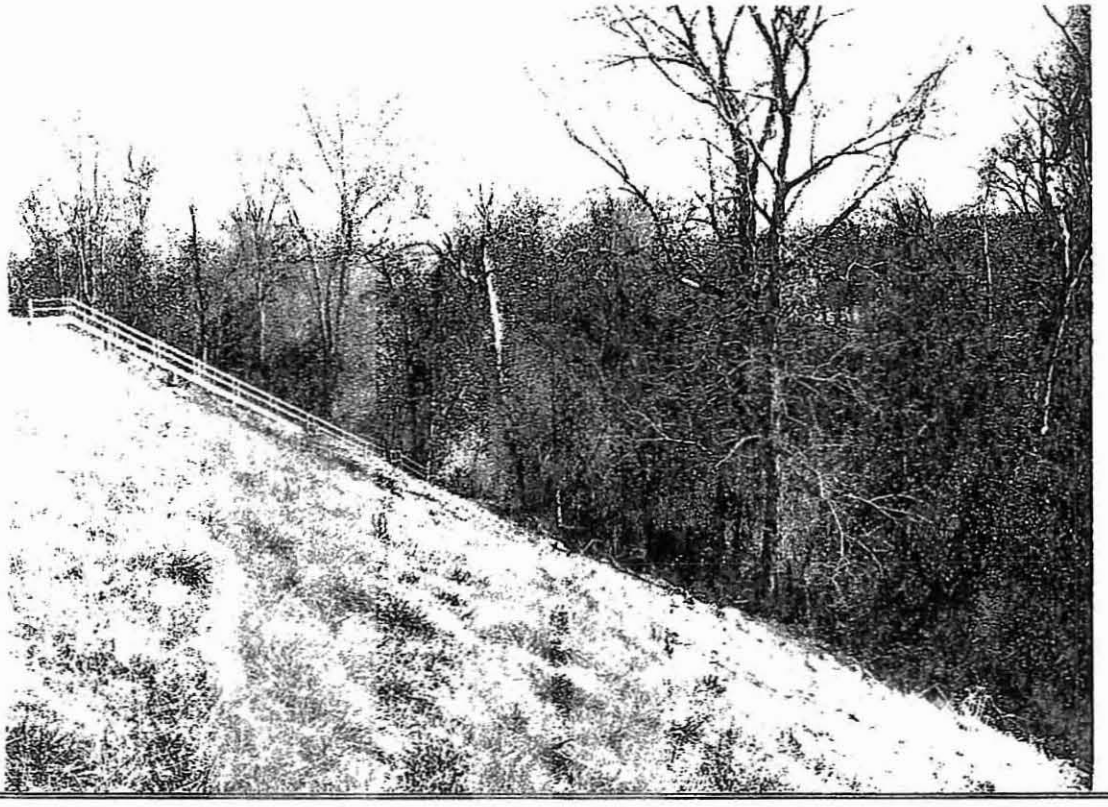
Downstream slope of primary basin just before intersection with intermediate dike. Note vegetation has been removed from riprap since 2001. Significant seep halfway between berm and road. See test for additional significant features observed in this vicinity.

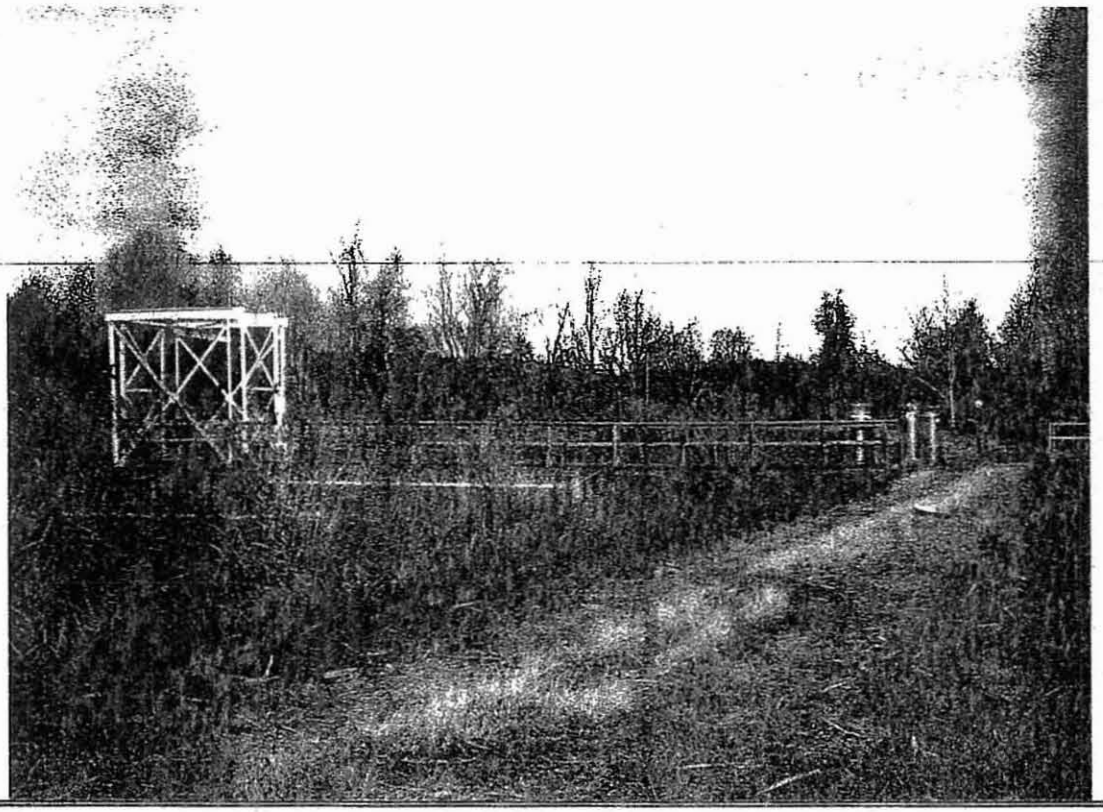
Remarks

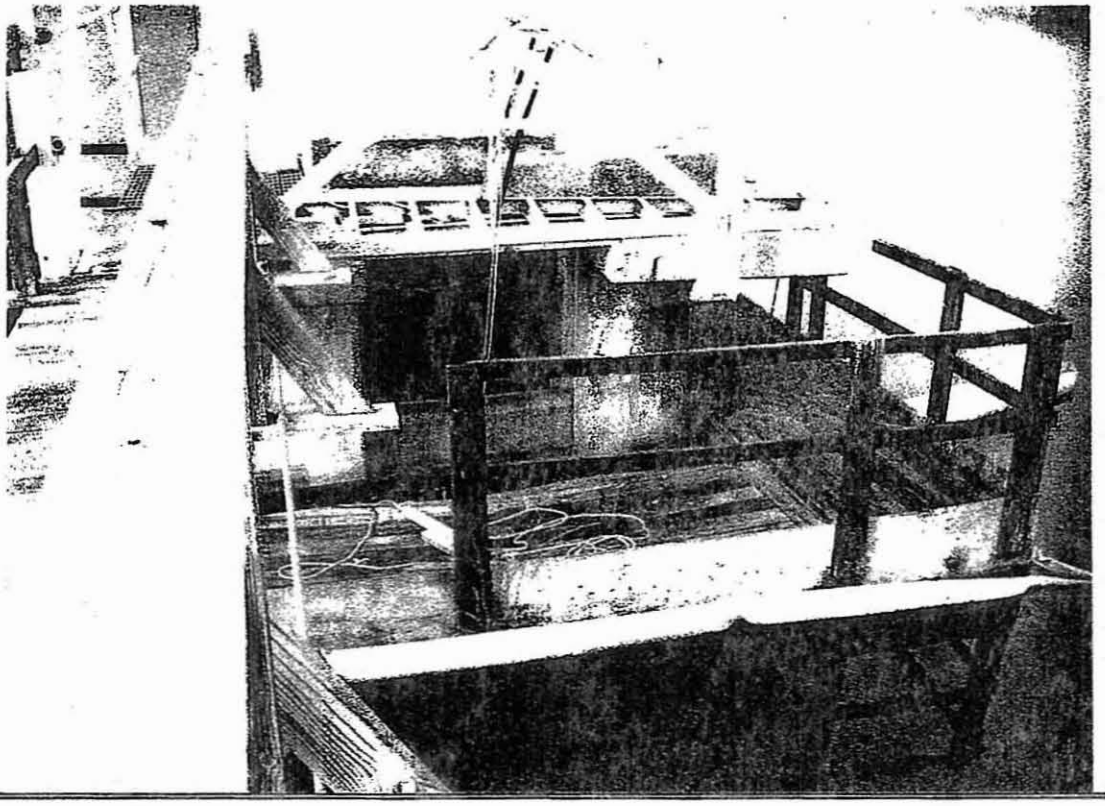
Photograph 22

Downstream side of secondary basin adjacent to Dan River. Note vegetation established in rip rap in 2001 has been removed. Some burrowing activity observed along top of riprap.

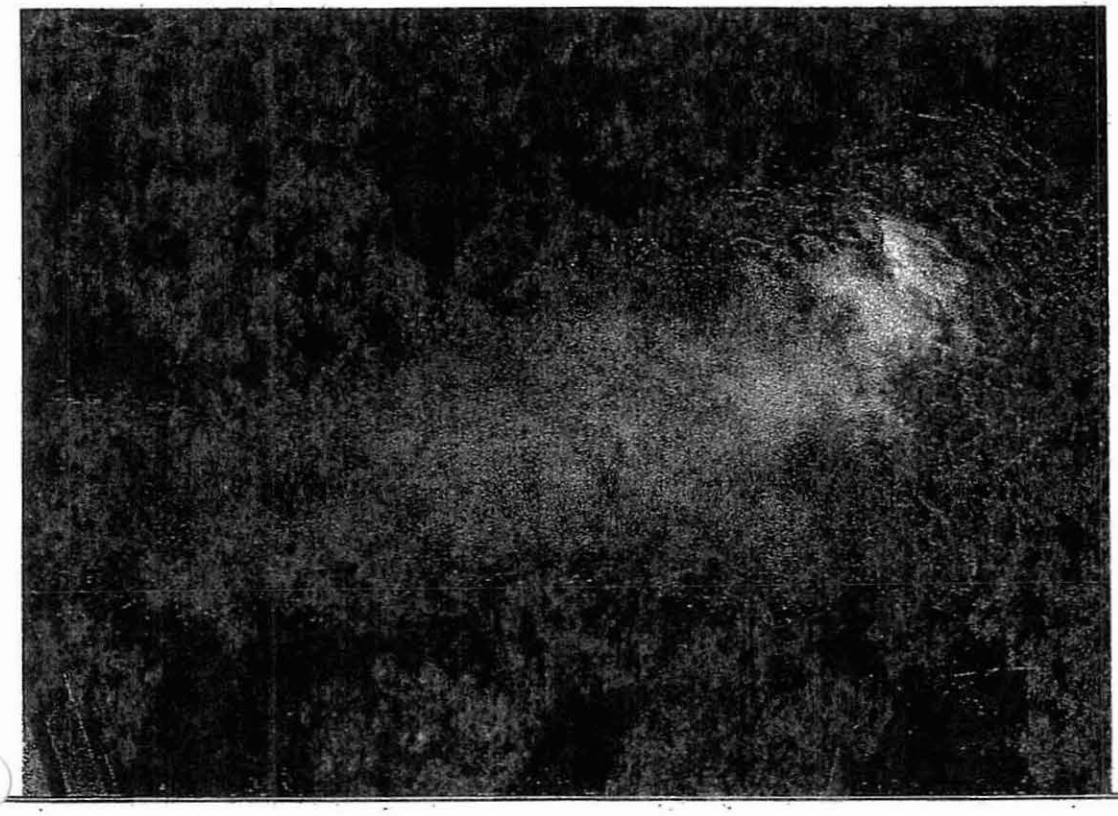
	Remarks
	**Photograph 23** Crest and downstream slope of secondary basin adjacent to Dan River. Steps leading to secondary basin pipe outfall have been replaced since 2001.

	Remarks
	**Photograph 23A** Riverbank is steep (active) and located nominally 10 ft from toe of dike in this vicinity.

	Remarks
	**Photograph 24** Discharge tower for the secondary basin.

	Remarks
	**Photograph 25** Discharge tower for the secondary basin.

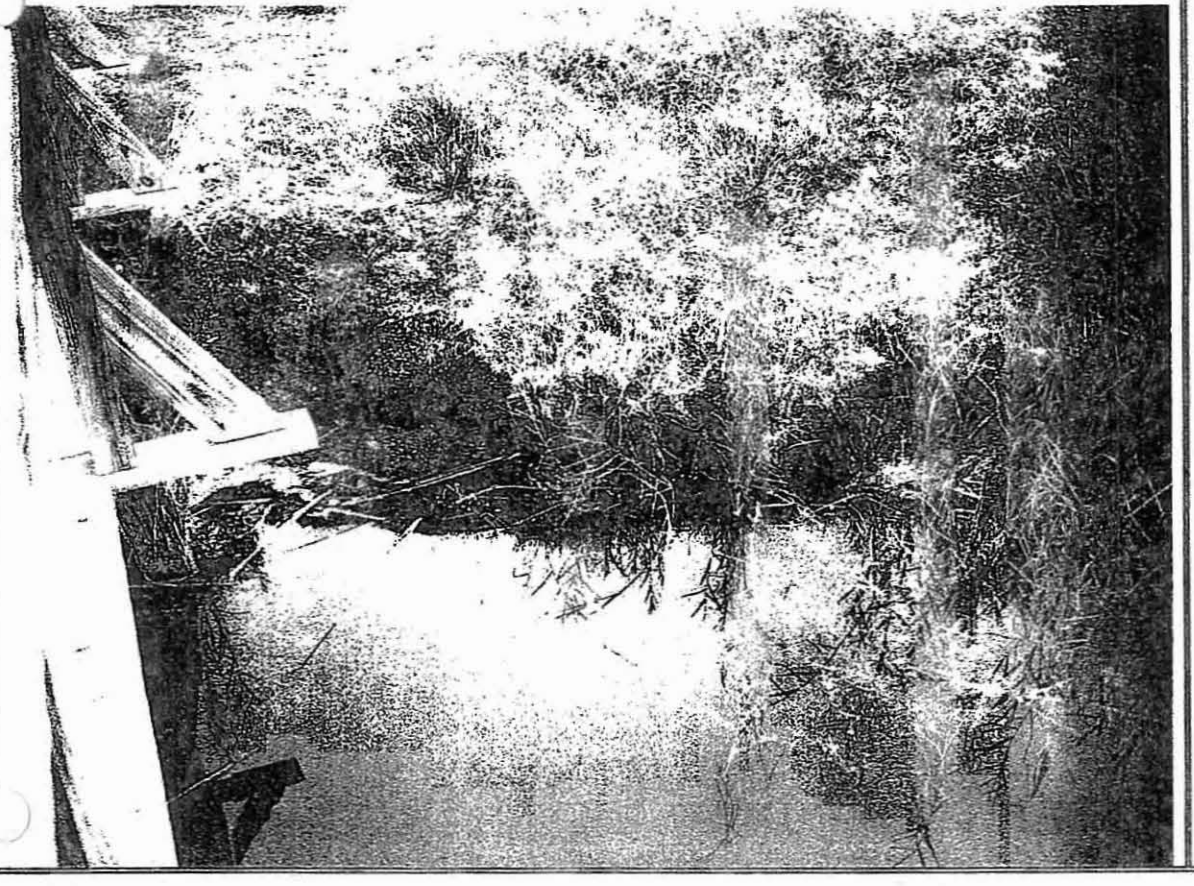
	Remarks
No Photograph – Photographer's view point for 2001 Photograph Not Accessible	**Photograph 26**

	Remarks
	**Photograph 27** Discharge path to Dan River. Straight edge on concrete (1996) now somewhat eroded, but apparently no significant change since 2001.

Remarks

Photograph 28

Downstream slope north embankment for secondary basin, looking S-SE. Wet area beyond toe still visible and may be surface drainage. No change since 2001.



Remarks

Photograph 28A

Upstream slope of secondary basin at discharge structure; note erosion or wave cutting first visible in 1996 that was not visible in 2001 due to vegetation.

	Remarks
	**Photograph 28B** Gully begins at toe of dike. No apparent change since 2001.

	Remarks
	**Photograph 29** Weir installed at inlet of 52-inch RCP between dry basin and primary basin. 52-inch RCP leads to drop box located under dike crest with 36-inch RCP outlet leading under ash storage basin to Dan River.

	Remarks
	**Photograph 30** Main dike for dry pond basin, E-NE view. Note continued presence of low place in crest apparently due to settlement.

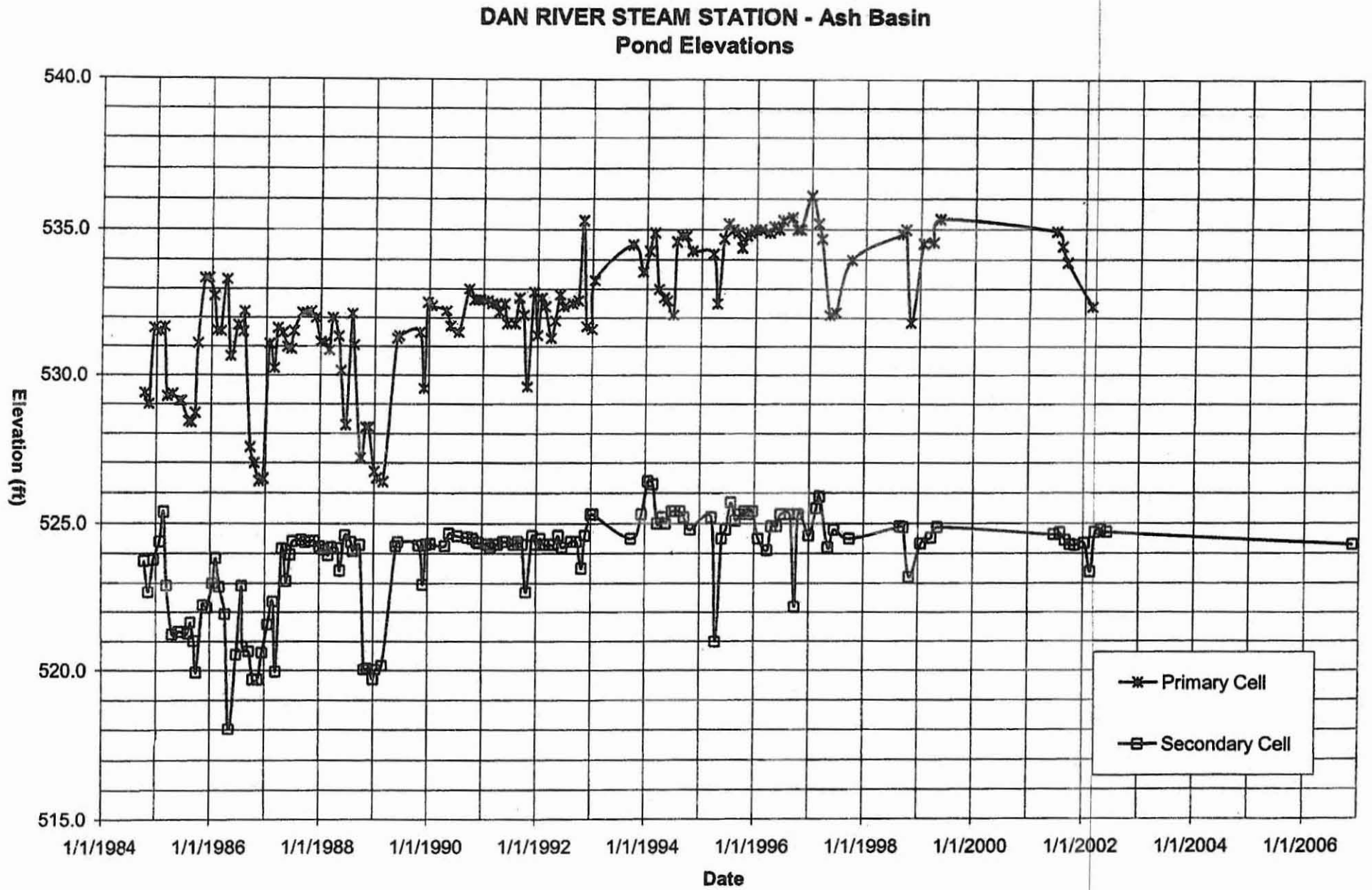
	Remarks
	**Photograph 31** Upstream slope of dry storage basin, E view.

	Remarks
	**Photograph 32** Former dredge pond, E-NE view; now filled with dry ash.

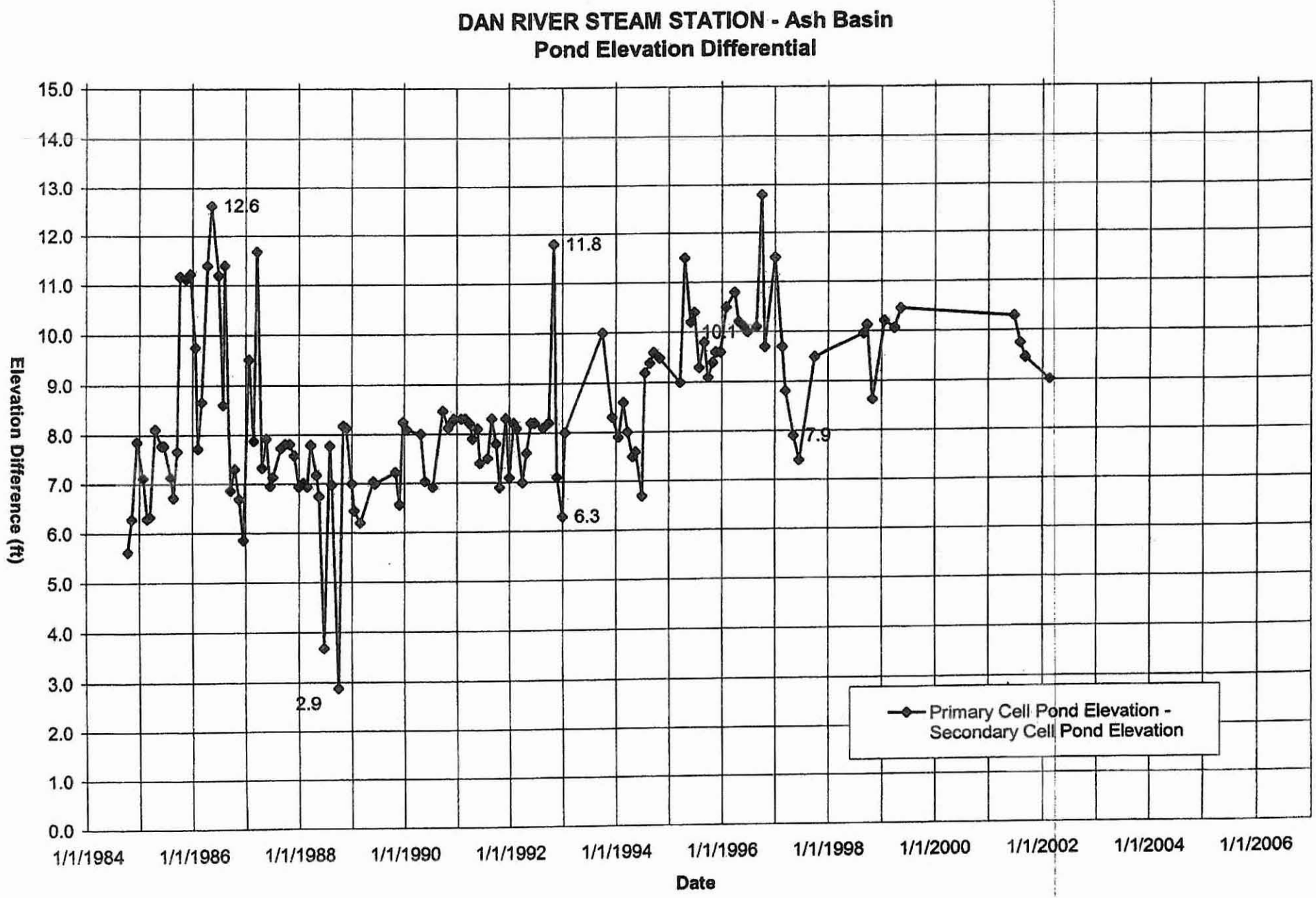
	Remarks

APPENDIX C

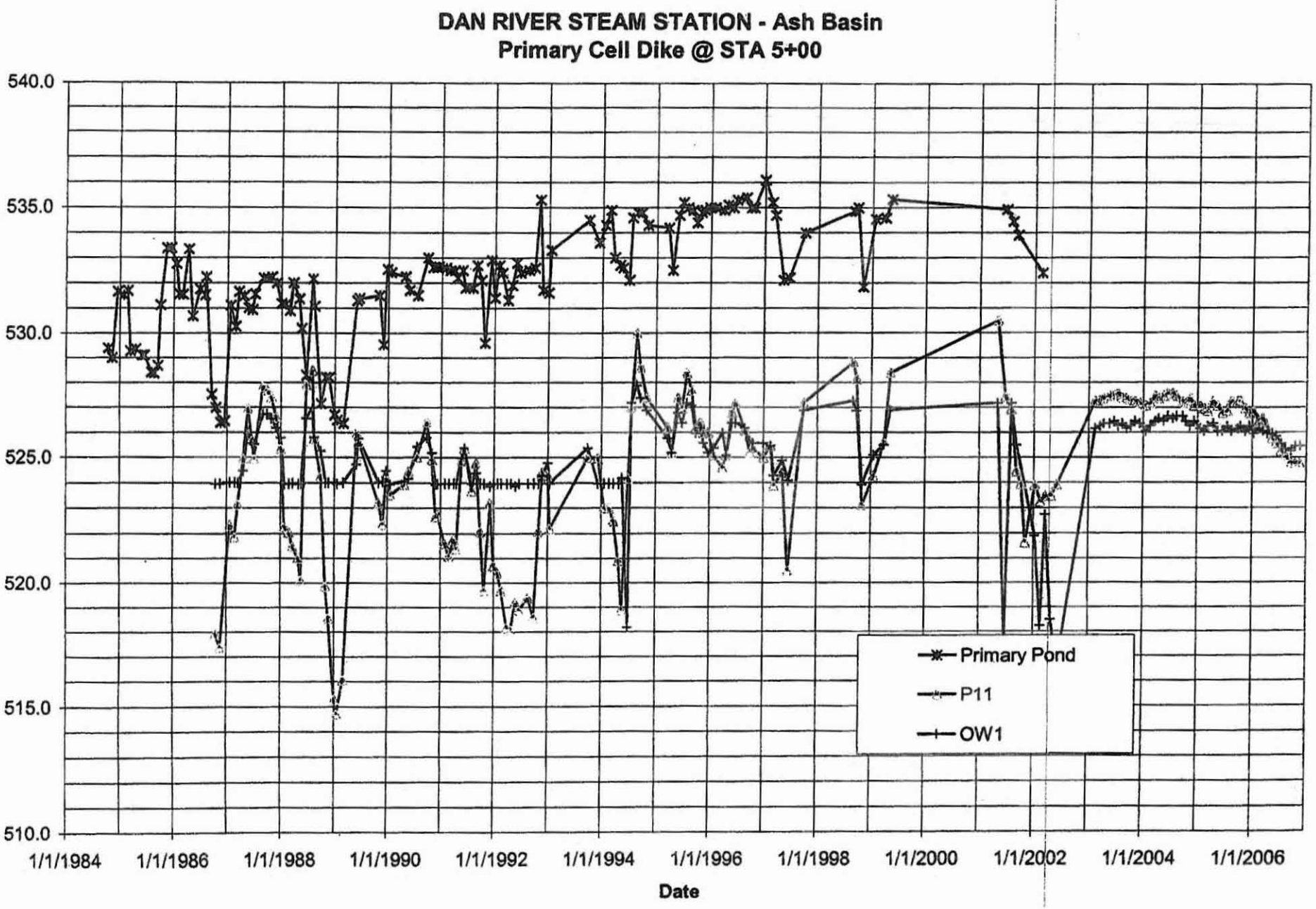
Monitoring Data



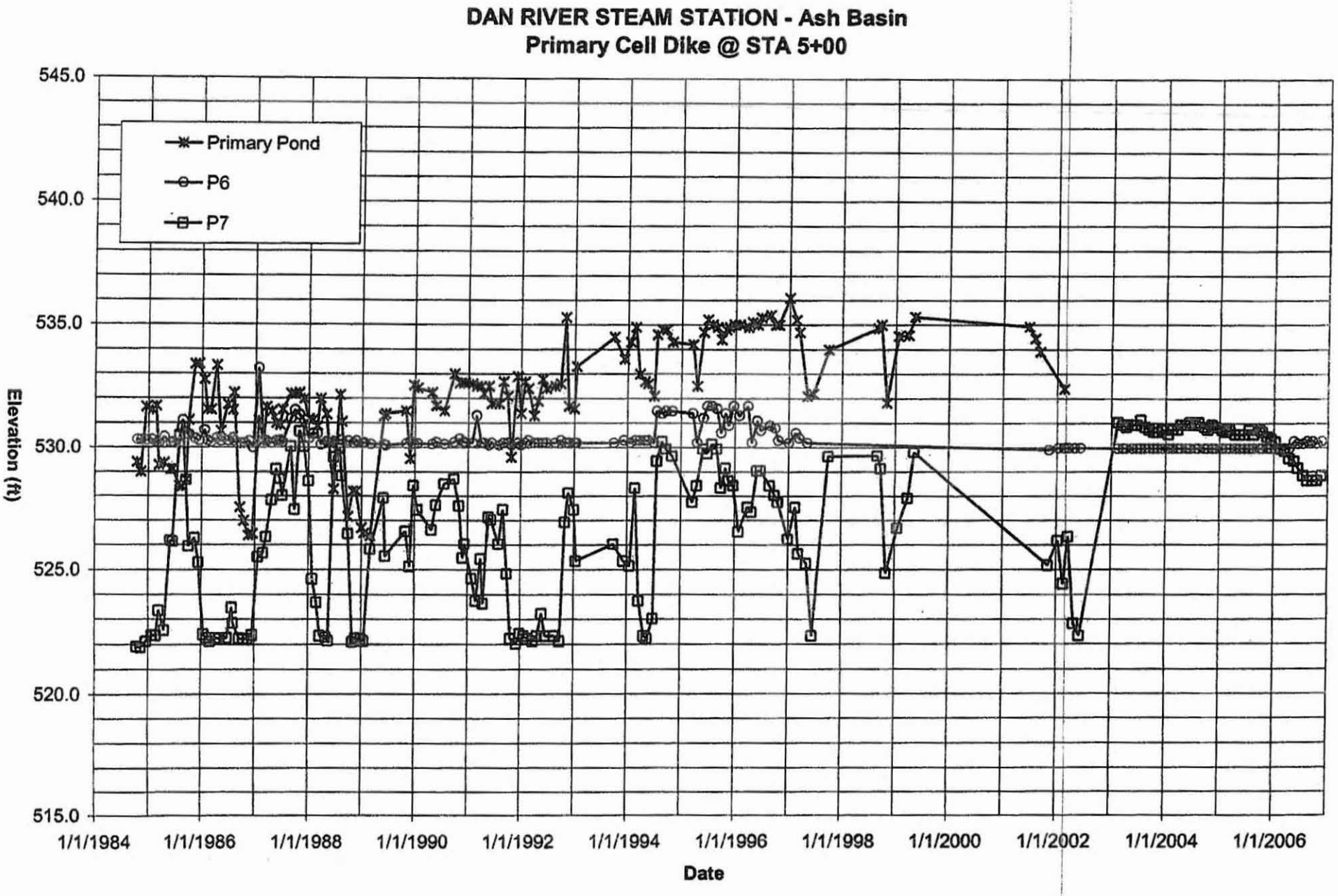
DR Piezometers 12-28-06.XLS



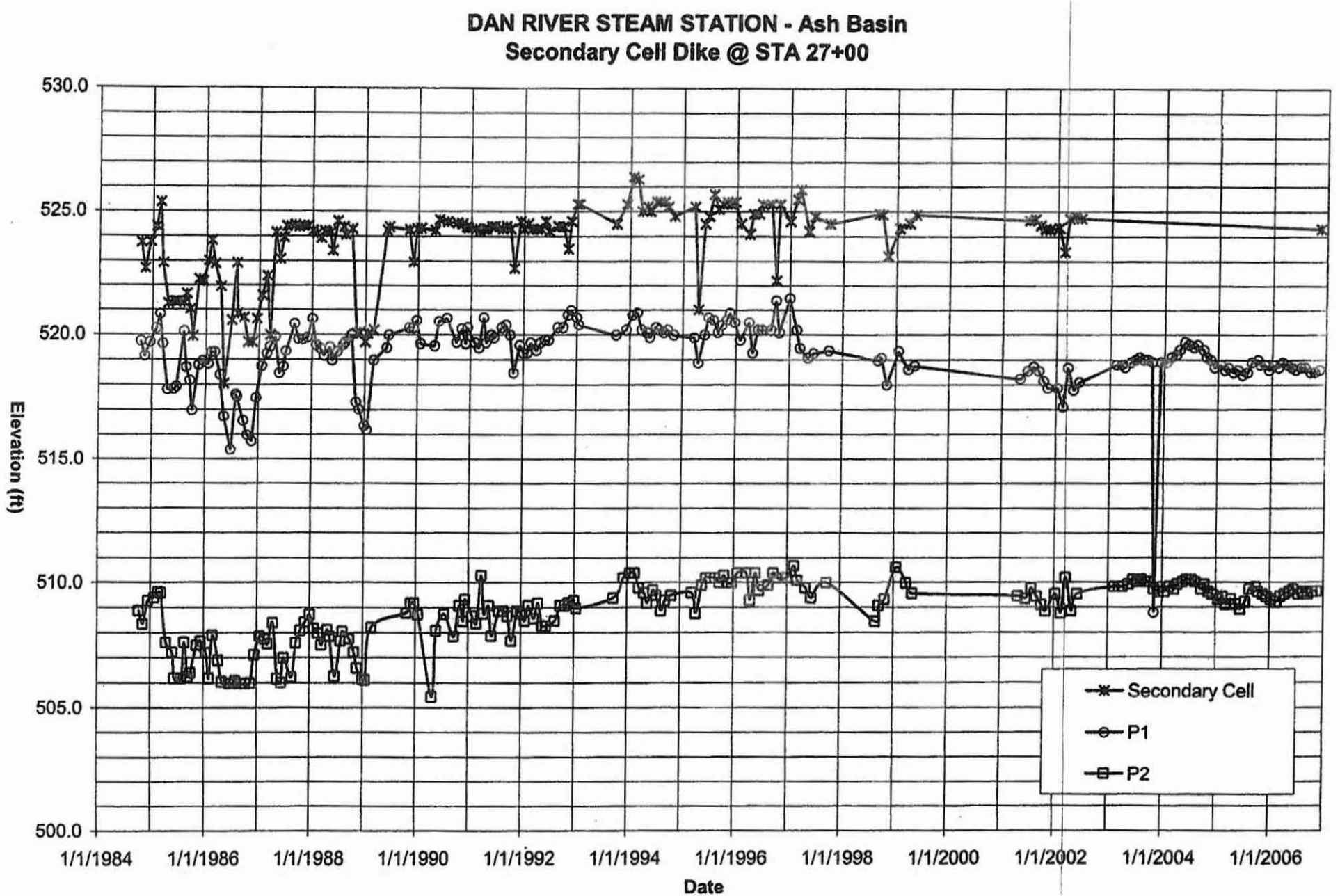
DR Piezometers 12-28-06.XLS



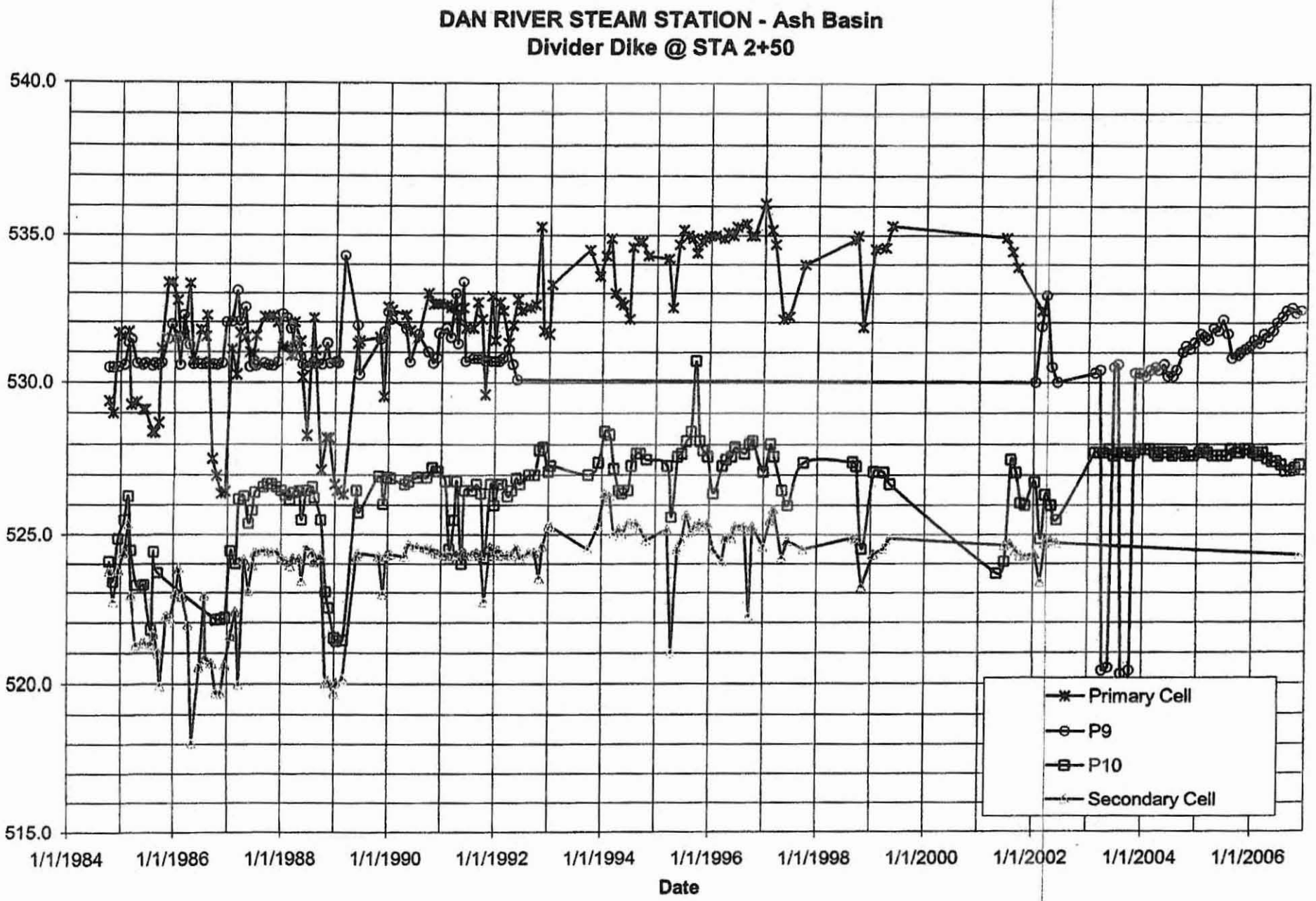
DR Piezometers 12-28-06.XLS



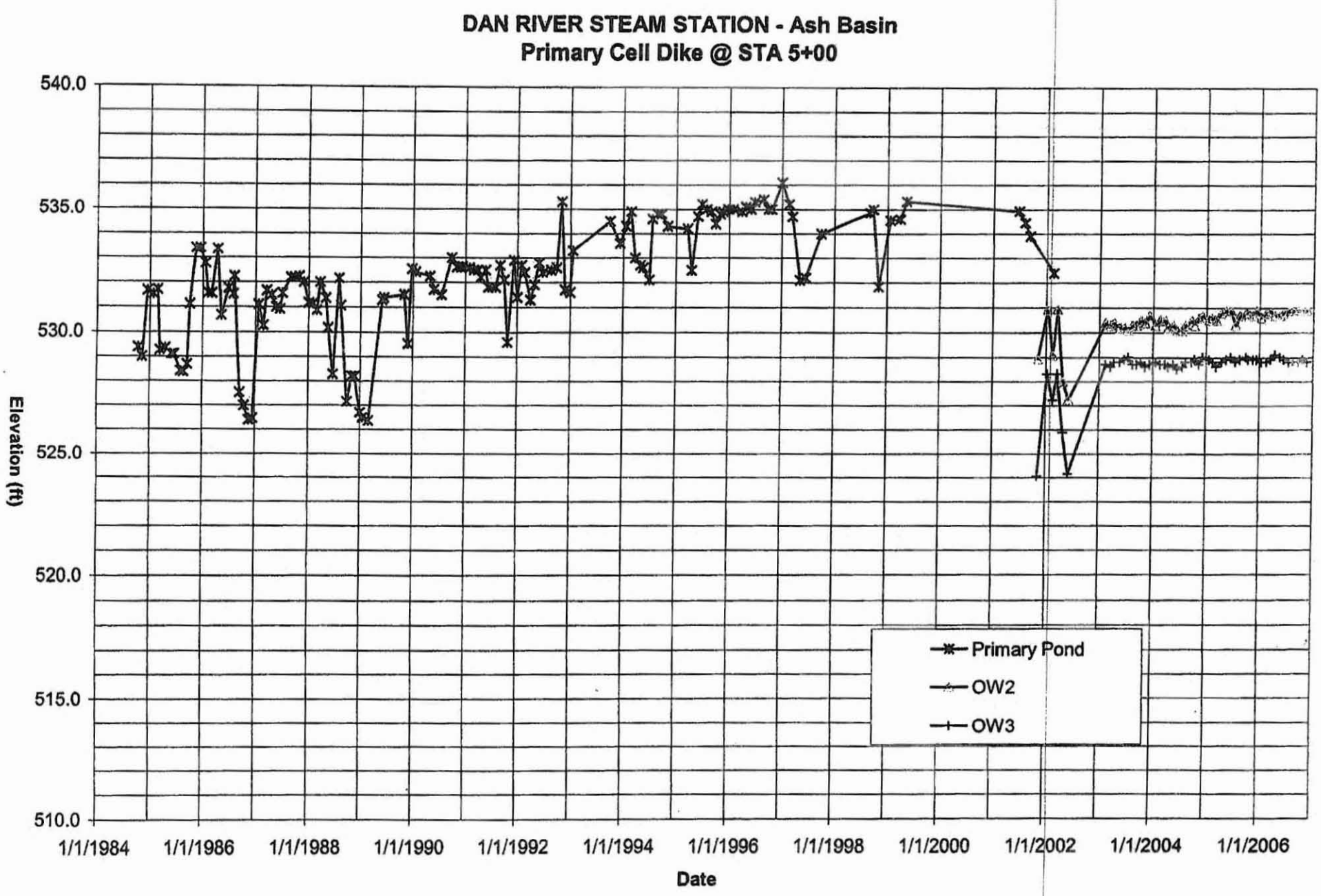
DR Piezometers 12-28-06.XLS



DR Piezometers 12-28-06.XLS



DR Piezometers 12-28-06.XLS



DR Piezometers 1-25-07.XLS

DAN RIVER STEAM STATION
PIEZOMETER MEASUREMENTS

Date	Piezometer Depth Measurements (feet)												
	P1	P2	P3	P4	P5	P6	P7	P9	P10	P11	OW1	OW2	OW3
2/12/2003	13.8	7.7	12.3(Dry)	8.7	8.8	13.1 (Dry)	4.3	12.7	8.7	9.8	10.9	12.7	5.6
3/19/2003	13.8	7.7	12.3(Dry)	8.6	8.8	13.1 (Dry)	4.4	12.6	8.7	9.8	10.8	12.8	5.7
4/11/2003	13.9	7.7	12.3(Dry)	8.8	8.7	13.1 (Dry)	4.5	22.6	8.7	9.7	10.7	12.7	5.5
5/21/2003	13/7	7.6	12.3(Dry)	8.6	8.8	13.1 (Dry)	4.4	22.5	8.6	9.6	10.7	12.9	5.5
6/20/2003	13.6	7.4	12.3(Dry)	8.6	8.9	13.1 (Dry)	4.4	12.5	8.8	9.6	10.6	12.9	5.4
7/16/2003	13.5	7.5	12.3(Dry)	8.5	8.9	13.1 (Dry)	4.2	12.4	8.7	9.5	10.8	13	5.3
8/14/2003	13.6	7.4	12.3(Dry)	8.6	9	13.1 (Dry)	4.5	22.7	8.7	9.7	10.7	12.8	5.6
9/12/2003	13.6	7.5	12.3(Dry)	8.7	8.9	13.1 (Dry)	4.6	23.7	8.7	9.7	10.9	12.8	5.6
10/10/2003	13.7	7.5	12.3(Dry)	8.8	8.8	13.1 (Dry)	4.7	22.6	8.8	9.8	10.8	12.6	5.5
11/8/2003	23.8	7.8	12.3(Dry)	8.7	8.9	13.1 (Dry)	4.7	12.7	8.7	9.8	10.6	12.7	5.7
12/10/2003	13.7	7.9	12.3(Dry)	8.8	9	13.1 (Dry)	4.6	12.7	8.6	9.9	10.7	12.4	5.6
1/19/2004	13.7	7.9	12.3 (Dry)	9	9.1	13.1 (Dry)	4.8	12.8	8.6	10	11	12.8	5.5
2/18/2004	13.5	7.7	12.3 (Dry)	8.8	9	13.1 (Dry)	4.6	12.6	8.6	9.9	10.8	12.6	5.6
3/23/2004	13.4	7.8	12.3 (Dry)	8.6	8.9	13.1 (Dry)	4.6	12.5	8.7	9.6	10.6	12.6	5.6
4/14/2004	13.2	7.6	12.3 (Dry)	8.4	9	13.1 (Dry)	4.4	12.6	8.8	9.7	10.5	12.9	5.7
5/19/2004	12.9	7.5	12.3 (Dry)	8.2	9	13.1 (Dry)	4.4	12.4	8.7	9.6	10.6	12.8	5.6
6/14/2004	13	7.4	12.3 (Dry)	8	8.8	13.1 (Dry)	4.3	12.8	8.7	9.5	10.4	13	5.8
7/20/2004	13.1	7.4	12.3 (Dry)	8	8.8	13.1 (Dry)	4.4	12.8	8.8	9.5	10.5	13	5.7
8/12/2004	13	7.5	12.3 (Dry)	8.2	8.9	13.1 (Dry)	4.3	12.6	8.7	9.6	10.4	12.8	5.5
9/22/2004	13.2	7.8	12.3 (Dry)	8.4	9	13.1 (Dry)	4.5	12	8.7	9.8	10.4	12.6	5.5
10/13/2004	13.5	7.6	12.3 (Dry)	8.5	9	13.1 (Dry)	4.6	11.8	8.8	9.9	10.6	12.8	5.4
11/11/2004	13.6	7.9	12.3 (Dry)	8.3	8.8	13.1 (Dry)	4.4	11.9	8.8	9.7	10.8	12.5	5.6
12/8/2004	13.9	8	12.3 (Dry)	8.8	9	13.1 (Dry)	4.5	11.7	8.8	10	10.6	12.4	5.3
1/19/2005	13.8	8.2	12.3 (Dry)	8.9	9	13.1 (Dry)	4.6	11.4	8.7	10	10.9	12.6	5.4
2/15/2005	14	8.1	12.3 (Dry)	9	9.1	13.1 (Dry)	4.7	11.5	8.6	10.1	11	12.5	5.5
3/10/2005	13.9	8.4	12.3 (Dry)	9.2	9.1	13.1 (Dry)	4.6	11.6	8.7	10.2	10.8	12.6	5.7
4/15/2005	14.1	8.2	12.3 (Dry)	9.3	8.9	13.1 (Dry)	4.8	11.2	8.8	9.8	10.7	12.3	5.5
5/18/2005	14	8.4	12.1	9.5	9	13.1 (Dry)	4.8	11.3	8.8	10	11	12.2	5.4
6/17/2005	14.2	8.6	12.3 (Dry)	9.6	9.1	13.1 (Dry)	4.8	10.9	8.8	10.3	11	12.2	5.3
7/19/2005	14.1	8.3	12.3 (Dry)	9	9	13.1 (Dry)	4.6	11.4	8.8	10.2	10.8	12.8	5.5
8/18/2005	13.7	7.8	12.3 (Dry)	9.3	8.9	13.1 (Dry)	4.8	12.2	8.6	9.8	11	12.4	5.4
9/28/2005	13.6	7.7	12.3(Dry)	9.3	8.8	13.1(Dry)	4.6	12.1	8.7	9.8	10.9	12.3	5.3
10/13/2005	13.8	7.9	12.3(Dry)	9.2	8.9	13.1(Dry)	4.7	12	8.7	9.8	10.8	12.3	5.4
11/16/2005	13.8	8	12.3(Dry)	9.3	8.8	13.1(Dry)	4.9	11.9	8.6	10.1	11	12.4	5.4
12/12/2005	14	8.1	12.3(Dry)	9.2	8.8	13.1(Dry)	5	11.8	8.6	10.3	10.8	12.2	5.4
1/11/2006	13.8	8.2	12.3(Dry)	9.4	8.9	13.1(Dry)	5.1	11.6	8.7	10.2	11.1	12.5	5.5
2/16/2006	13.9	8.3	12.3(Dry)	9.5	9	13.1(Dry)	5.4	11.7	8.8	10.6	10.9	12.3	5.5
3/15/2006	13.7	8.1	12.3(Dry)	9.6	8.7	13.1(Dry)	5.5	11.4	8.7	10.5	11	12.2	5.4
4/14/2006	13.8	8	12.3(Dry)	9.6	8.8	13.1 (Dry)	5.8	11.5	8.9	10.9	11.1	12.4	5.2

DAN RIVE[illegible]AM STATION
PIEZOMETER [illegible]ASUREMENTS

5/17/2006	13.9	7.9	12.3(Dry)	9.8	8.9	.12.8	5.9	11.3	9	11.3	11.1	12.4	5.3
6/12/2006	14	7.8	12.3(Dry)	9.9	8.7	12.9	6.2	11	9	11.5	11.2	12.3	5.4
7/18/2006	13.9	8	12.3(Dry)	10	8.9	12.9	6.5	10.8	9.1	11.8	11.5	12.2	5.5
8/15/2006	13.9	7.9	12.3(Dry)	9.9	8.8	12.8	6.7	10.6	9.3	12	11.7	12.2	5.5
9/20/2006	14.1	8	12.3 (Dry)	10.1	8.8	12.8	6.7	10.5	9.3	12.3	11.8	12.2	5.5
10/19/2006	14.1	7.9	12.3 (Dry)	10	8.8	12.9	6.7	10.7	9.2	12.3	11.6	12.2	5.4
11/21/2006	14	7.9	12.3 (Dry)	9.8	8.9	12.8	6.5	10.6	9.1	12.3	11.6	12.2	5.5
12/11/2007	14	7.8	12.3 (Dry)	9.8	8.9	12.9	6	10.8	9	11.9	11.4	12.2	5.8
1/18/2007	14.1	7.8	12.3 (Dry)	9.9	8.9	12.9	5.4	11	9	11.6	11.1	12.3	6
2/9/2007	14.1	7.9	12.3 (Dry)	9.8	8.9	13	5	11.2	8.9	11.3	10.8	12.4	6.2
3/16/2007	14	7.8	12.3 (Dry)	9.8	8.8	13	4.8	11.4	8.8	11	10.4	12.4	6.5
4/13/2007	13.9	7.9	12.3 (Dry)	9.7	8.6	13.1 (Dry)	4.4	11.6	8.8	11	10.2	12.4	6.8
5/11/2007	14.1	7.8	12.3 (Dry)	9.7	8.8	13.1 (Dry)	4.2	11.8	8.6	10.8	10	12.5	7
6/14/2007	14	7.8	12.3 (Dry)	9.6	8.8	13.1 (Dry)	4.1	11.6	8.6	10.8	9.8	12.5	7.2
7/19/2007	13.9	7.9	12.3 (Dry)	9.5	8.8	13.1 (Dry)	3.8	11.8	8.4	10.6	9.4	12.7	7.4
8/15/2007	14	8	12.3 (Dry)	9.5	8.9	13.1 (Dry)	3.6	11.8	8.3	10.4	9.5	12.6	7.5
9/18/2007	14.2	8	12.3 (Dry)	9.6	8.8	13.1 (Dry)	3.3	11.9	8.3	10.3	9.4	12.6	7.6
10/10/2007	14.1	8.2	12.3 (Dry)	9.8	8.7	13.1 (Dry)	3.5	12.1	8	10.2	9.2	12.8	7.8
11/13/2007	14.3	8.2	12.3 (Dry)	9.7	8.8	13.1 (Dry)	3.3	12	8.2	10.5	9	13.1	8
12/8/2007	14.3	8.3	12.3 (Dry)	9.7	8.8	13.1 (Dry)	3.1	12.3	8.1	10.5	8.9	13.2	8